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COUNTRY REPORTS ON THE PROGRESS MADE SINCE THE ELEVENTH CONFERENCE

Cartographic work in Japan, 1986-1989

Paper submitted by Japan

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SUMMARY

In Japan, fundamental geodetic projects are carried out mainly by the Geographical Survey Institute (GSI) and the Hydrographic Department (HD). Various map production works are conducted by GSI, HD, the National Land Agency (NLA), the Ministry of Agriculture, Forestry and Fisheries (MAFF) and the Geological Survey of Japan (GSJ).

Recent principal geodetic survey activities in Japan are as follows: precise geodetic control and subsistence detection of crustal movement for earthquake prediction research, levelling in the ground subsidence areas, geodetic satellite observation for control of the geodetic network and for determination of positions of isclated islands, etc., astronomical observation for establishment of Laplace stations and for compilation of nautical almanacs and ephemerides, gravity measurement for preparation of gravity anomaly charts, and geomagnetic observation for preparation of geomagnetic charts.

In addition to those geodetic activities, global geodetic projects which connect the Japanese geodetic network to the world geodetic system are being undertaken by GSI, utilizing the Very Long Baseline Interferometer (VLBI) system, and by HD, utilizing the geodetic satellite "AJISAI", respectively.

GSI undertakes periodic surveys to revise national base maps on the scale of 1:25,000, preparation of topographic maps ranging in scale from 1:2,500 to 1:3,000,000, and several kinds of thematic mapping, such as land-use maps and land-condition maps. It also publishes many kinds of topographic maps ranging in scale from 1:2,500 to 1:3,000,000. Besides general maps, GSI prepares several other kinds of thematic maps, such as land-use maps and land-condition maps. In 1990, GSI published the revised edition of the National Atlas of Japan, which was first published in 1977.

NLA has been conducting a cadastral survey. The scales of cadastral maps are from 1:250 to 1:5,000.

MAFF has been producing soil maps of cultivated and forest lands and has already covered all the national forests in a series of soil maps.

GSJ has been producing geological maps on the scale of 1:50,000 and geological and sedimentological maps of the continental shelves on the scale of 1:200,000.

To promote safe navigation, HD has been publishing various nautical, bathymetric and tidal current charts.

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Most of the cartographic work carried out in Japan is under the auspices of The Survey Law to efficiently coordinate and standardize accuracy and avoid overlapping work.

It is classified into two categories. The first is the Fundamental Survey, nation-wide, executed by the Geographical Survey Institute (GSI), and the second is the Public Surveys for special projects or local governmental projects, which are carried out by other governmental or public organizations such as the Forestry Agency, the Geological Survey of Japan, the National Land Agency, etc. Preparation of various kinds of hydrographic charts is carried out by the Hydrographic Department (HD), Maritime Safety Agency.

1. Geodetic Work

Fundamental geodetic work done in Japan is principally executed by the Geographical Survey Institute (GSI) and the Hydrographic Department (HD).

The Japanese national geodetic network consists of 1,000 1st order triangulation points, 5,000 2nd order triangulation points, 32,700 3rd order triangulation points and 59,000 4th order triangulation points and 20,000 km of precise leveling routes. 4th order triangulation points are still being added mainly for cadastral surveys.

1.1 Precise Geodetic Network Surveying Project

The GSI started the Precise Geodetic Network Surveying Project in 1974 in order to switch over from its old geodetic data obtained by conventional methods to more precise new geodetic data by trilateration, using optical EDMs. The geodetic framework of the project is classified into two networks. One is a Primary Precise Geodetic Network composed of 6,000 1st and 2nd order triangulation points, and the other is a Secondary Precise Geodetic Network composed of 32,700 3rd order triangulation points.

The new data can serve not only as a revised framework for mapping, but also for earthquake prediction and research on crustal movement in Japan.

1.2 Leveling

The GSI completed the 7th revision leveling survey along the first order leveling routes throughout Japan in 1987 and started the 8th revision survey in the same year. About 2,000 km of revision surveys are being carried out every year.

In addition to the revision survey, the GSI is conducting 1,000 km of releveling annually in the Specified Observation Areas and the Intensified Observation Areas

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designated in the National Earthquake Prediction Project; furthermore, 12,000 km of releveling is performed annually in and around ground subsidence areas along the coast by the GSI, in cooperation with local governments.

One hundred five tidal stations are registered with the Coastal Movement Data Center and all the tidal data obtained at those stations are compiled and published every year.

The HD is carrying out cross-sea leveling and the observation of vertical deflection annually in the Izu Syoto, which is a tectonically active area in the seas about Japan. It provides data for elucidation of the crustal structure of this locality.

1.3 Satellite Positioning

The GSI has been using a NNSS to: (a) detect the possible distortion of the geodetic network of Japan, (b) determine the geodetic coodinates of islands isolated from the mainland, (c) study the geotidal height, (d) connect the geodetic network to those of other countries. The HD also is engaged in satellite positioning.

In order to measure the precise position of the mainland and islands of Japan in the World Geodetic System, the Hydrographic Department of Japan has continuously conducted a satellite laser ranging (SLR) observation of LAGEOS at the Shimosato Hydrographic Observatory since 1982, and has constantly determined the positions of more than 40 off-lying islands by means of the translocation observation of NNSS since 1974.

Prior to the launch of the Japanese geodetic satellite AJISAI on August 13, 1986, a new branch named the Satellite Geodesy Office, with 16 members in the staff now, was established at the Department in April 1986 to conduct the whole satellite-based geodesy including the above two observations. In 1986 and 1987, some new observation facilities were introduced such as the transportable SLR systems, the fixed and transportable satellite cameras as well as a computer system named the Satellite Data Reduction System. Also, 3 new members were added to the staff of Shimosato Hydrographic Observatory at the same time.

With these new staff members and by using these new equipments and the fixed SLR system at the Observatory, the Department started a new 5 year project in 1988 to determine the precise position of 10 major islands from the simultaneous observation of AJISAI. The Observations were performed at Titi-sima (the biggest in Bonin islands) and Isigaki Sima in 1988, at Minami-Tori Sima (Marcus Island), Okinawa Sima and Tusima in 1989. The observations at Oki Syoto and Minami-Daito Sima are planned in 1990.

Both of these SLR observations are supported by a Japan-U.S.A. cooperative research under the umbrella of U.S.A-Japan Cooperation in the field of space development. The cooperative research is related with the Crustal Dynamics Project conducted by NASA.

The obtained data were analyzed by the method SPORT (Successive Passes Orbit Revising Technique) developed at the Department to determine the relative positions of these major islands referred to Shimosato as precisely as the uncertainty 7 mm for the baseline

length of about 2,000 km in the case of Minami-Tori-sima.

In order to watch the crustal deformation for middle size (about 50 km) baselines in the Sagami-bay, well known as the nest of big earthquakes, the Department started a continuous monitoring, at least a one day session each week, of GPS geodetic survey for the triangle of Izu-Osima, Manazuru and Turugi-saki since February 1990.

1.4 Astronomical Observation

The GSI is carrying out the observation of the astronomical azimuth, latitude and longitude to establish Laplace stations in the Primary Precise Geodetic Network.

The HD is also carrying out the observation. For the purpose of preparing the Japanese Ephemeris (the most precise almanac in Japan), nautical almanac, abridged nautical almanac, etc., the Hydrographic Department has been conducting observations of occultation of stars by the moon at the hydrographic observatories at Tokyo, Shirahama, Shimasato, and Bisei, and grazing occultation at two places in Japan.

1.5 VLBI Survey

The GSI has been conducting mobile VLBI observations since 1986 with the cooperation of the Communications Research Laboratory (CRL), Ministry of Post and Telecommunication. Its VLBI system visited Miyazaki in 1986 and 88, Chichi-sima in 1987 and 89. From the results of the Chichi-sima experiments, the motion of the Philippine Sea plate was successfully detected. The GSI will continue the operation of the VLBI system to (a) detect crustal deformation, (b) control the Precise Geodetic Network and (c) establish GPS (Global Positioning System) satellite tracking stations.

1.6 Gravity Survey

Gravity Surveys are executed on land by the GSI and at sea by the HD. The GSI is repeating fundamental and 1st order gravity surveys at fundamental and 1st order gravity stations to detect gravity changes associated with crustal movements. Since 1984, an absolute gravity measuring system has been operated for the fundamental gravity survey.

The GSI also continues 2nd order gravity surveys at leveling and triangulation points. Those data are concentrated on the preparation of Bouguer anomaly and free air anomaly charts and are provided for the study of geoidal height in and around the islands of Japan and the study of underground structures.

The HD has been conducting gravity measurements. For the purpose of detecting crustal deformation of the Izu Islands in the Minami Kanto district, precise over sea levelings by measuring gravity and the usual optical trigonometric method are conducted in the Izu Islands every year. These observation data are used to delineate vertical

crustal movement related with earthquake and volcanic eruption.

1.7 Geomagnetic Survey

The GSI has been conducting continuous land geomagnetic and aeromagnetic surveys. The former at 105 1st order geomagnetic stations at about three year intervals.

The data obtained by the GSI are used for compilation of magnetic charts on the scale of 1:2,500,000 for D(declination) and 1:4,000,000 for H(horizontal intensity), I(inclination), Z(vertical intensity) and F(total intensity) components.

The GSI is preparing to revise D, H, I, F, component charts in 1992, using the data obtained from the period between 1952 and 1990 which were reduced to the common epoch 1990.0. In addition to these, the GSI is carrying out an aeromagnetic survey to revise aeromagnetic total intensity chart published for 1975.0.

The HD conducted landmagnetic and aeromagnetic surveys on and over the Japanese islands and its surrounding waters. In order to maintain the safety of a vessel or an aircraft using a magnetic compass, magnetic variations and annual changes must be shown on the nautical and aeronautical charts. For that, the Hydrographic Department is regularly conducting geomagnetic observations and measures magnetism and annual variations by means of airborne magnetic surveys on and around Japan and land magnetic surveys at the repeated observation points every five years.

At the time of the volcanic eruption of Izu-Osima island in November 1986, repeated airborne magnetic surveys were conducted to detect magnetic change and magnetic structure of the volcano. For the purpose of volcanic prediction of the Izu-islands, airborne magnetic surveys for Izu-islands were also carried out.

1.8 Unmanned Survey Craft

The HD is developing an unmanned survey craft. In order to make it possible to carry out hydrographic surveys in a dangerous area, where such as submarine volcanic eruption is likely to occur, the Hydrographic Department developed a remote-controlled unmanned survey craft in 1988. The craft, nicknamed "MANBO", well proved its practical capability of hydrographic survey, when a submarine volcano erupted off the Izu Hanto (Peninsula) in July 1989.

For the earthquake prediction programme, one of the most important objectives is to make geophysical observations at sea-bottom. In response to this demand, some development schemes to observe crustal deformation at sea-bottom were launched in 1989, in cooperation with Japan Hydrographic Association. The operation and improvement of the unmanned survey craft was also conducted in relation with this project.

1.9 The Earthquake Prediction Program

The HD surveys for the earthquake prediction program. In order to obtain data and information necessary for the prediction of earthquakes, the Department has been carrying out surveys and investigations for submarine topography and active sea-bottom structures in specific areas off Miyagi and Fukushima (scale: 1/100,000) in which large-scale earthquakes have occurred before, as well as on Sagami-Nankai Trough (scale: 1/50,000) which is designated as the Intensive Observation Areas for earthquakes.

For this purpose, magnetic and gravity surveys were also conducted around the Izu-Bonin island arcs and other plate boundaries. Total intensity magnetic anomaly and Free-air gravity anomaly maps were made for elucidation of sea-bottom structure. Free-air gravity anomaly is also used to calculate the precise geoid.

Table 1. Geodetic Work for the Period from 1986 to 1989

		1986	1987	1988	1989	total
Primary Precise Geodetic Network		736	592	544	464	2,336
Secondary Precise Geodetic Network		129	142	119	103	493
Fourth-order Triangulation		1,268	1,156	1,122	1,103	4,649
Satellite Laser Ranging	inland	HD	since 1982			1
	islands	HD		2	3	5
Satellite Doppler Positioning	inland	GSI 2	15	9	36	62
	islands	GSI 1	2	10	9	22
		HD 5	0	9	11	25
	others	Korea			4	4
Laplace Station		1	1	1	1	4
Astronomical Observation		6	5	5	5	21
Gravity Survey	fundamental	3	2	2	1	8
	1st-order	29	24	30	140	223
	2nd-order	159	158	113	5	435
	High Density (km)	—	—	—	324	324
First-order Geomagnetic survey		30	22	27	28	107
12th Whole Japan Magnetic Survey Project (HD)					2	2
Aeromagnetic Survey	land(GSI) km	64,700	60,360	78,200	0	203,260 km
	land/sea(HD)	5,000	5,000	2,000	18,000	30,000 km
First Order Revision Leveling		2,511	2,218	2,253	2,144	9,166 km

2. Topographic Mapping

2.1 Medium Scale Topographic Maps

The national base map series, covering the entire country of Japan, 1:50,000 scale topographic map was begun in 1895, and was completed in 1925.

About 40 years later, the 1:25,000 scale topographic map was adopted by the GSI as the national base map replacing the 1:50,000 scale map under a medium scale topographic map development program. The map encompassing the whole country of Japan was completed in 1983.

The GSI has been conducting a revision survey and the recompilation of these maps utilizing the following principles:

1) The revision of the 1:25,000 maps is conducted at intervals of 3 (urban areas), 5 (intermediate areas) or 10 (mountainous areas) years, depending on the extent of unit change in the map sheet.
2) The 1:50,000 sheets are revised simultaneously with the revision of the corresponding 1:25,000 scale topographic maps.
3) The projects to interpret the extent of the changes are carried out by Regional Survey Departments of the GSI, which are located at 10 locations throughout the country.

2.2 Large Scale Topographic Maps

The GSI initiated the National Large Scale Topographic Mapping Project in 1960, in order to cover 190,000 km² of flat areas of the country. The Forestry Agency also began promoting a similar project in mountainous areas, for the purpose of producing a Bacic Forest Map as the basis for surveying forests. The project covering mountainous areas was completed in 1980. Currently the Forestry Agency is promoting revision works of the existing Basic Forest Map.

Until 1974, local public organizations had been producing large scale urban planning base maps with their own standards. Since 1975, the GSI and the City Bureau of the Ministry of Construction has standardized 1:2,500 urban planning mapping process by promoting the 1:2,500 map cooperative project. In the project, the GSI will take aerial photograph and do aerial triangulation and local public bodies will make maps. Around 50,000 km² of urban planning area is mapped according to the standard. These maps are in principle revised every five years.

In 1983, the GSI began producing 1:10,000 scale topographic maps for urban areas. This 1:10,000 scale map has been produced by utilizing the existing 1:2,500 scale maps.

Table 2 shows the amount of large and medium scale topographic mapping work undertaken during the past four years.

Table 2. Large and Medium Scale Topographic Mapping

		1986	1987	1988	1989
1: 2,500	New edition	18 ㎢	- ㎢	6 ㎢	13 ㎢
	Revision	- ㎢	- ㎢	- ㎢	- ㎢
1: 5,000	New edition	544 ㎢	653 ㎢	338 ㎢	145 ㎢
	Revision	- ㎢	- ㎢	48 ㎢	- ㎢
1: 5,000	Photomap	268 ㎢	252 ㎢	192 ㎢	120 ㎢
1:10,000	New edition	797 ㎢	821 ㎢	718 ㎢	524 ㎢
	Revision	- ㎢	91 ㎢	494 ㎢	698 ㎢
1:25,000	Revision	42,382 ㎢	40,396 ㎢	42,389 ㎢	38,652 ㎢
	Recompilation	3,140 ㎢	2,328 ㎢	1,840 ㎢	1,099 ㎢
1:50,000	Revision	89 sheets	117 sheets	112 sheets	181 sheets
	Recompilation	7 sheets	3 sheets	6 sheets	4 sheets

Table 3 shows the basic forest mapping work during the same period.

Table 3. Basic Forest Mapping

	1986	1987	1988	1989
1: 5,000 Photomaps	6,481 ㎢	5,991 ㎢	5,558 ㎢	5,222 ㎢
1: 5,000 BFM Revision	1,500 ㎢	1,331 ㎢	1,814 ㎢	1,653 ㎢

2.3 Small Scale Maps

Small scale maps published by the GSI as of the end 1989 are shown in Table 4.

Table 4. Status of Small Scale Map Preparation

Title	Number of sheets	Size	Number of colors	Remarks
1: 200,000 scale Regional Map	130	46 × 58 cm	6	Layered edition
1: 500,000 scale District Map	8	788 × 1,091 cm	9	
1: 500,000 scale District Map	8	〃	4	
1:1,000,000 scale IMW	3	〃	12	
1:1,000,000 scale NIPPON	3	〃	4	
1:3,000,000 scale Japan & Her Surroundings	1	〃	12	Layered edition, Hill shading edition
1: 100,000 scale Composite Map	2	〃	4	Tokyo & Vicinity Shikotsu, Toya & Vicinity Osaka & Vicinity

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The International Map of the World on the one millonth scale (IMW) is compiled by utilizing standard international map symbols. Preparation of this map requires close cooperation with the various countries of the world, so that the map symbols, method of preparation, etc., are prepared carefully in compliance with the requests of the United Nations, in order to reflect the results of the study of the international map of Japan.

2.4 Geographical Information and Digital Mapping

a) Digital National Land Information

In order to promote effective use of land resources, GSI started data collection of Digital National Land Information in cooperation with the National Land Agency in 1974. Various categories of information, such as elevation, coast lines, rivers, roads, railways, political boundaries, land use, etc., have been collected from 1:25,000, 1:50,000 and other smaller scale maps and filed onto magnetic tape under each category.

The information has been used not only for the planning of national land, but also for city, water use, environmental assessment planning and other various applied fields.

b) Detailed Digital Land Use Data

GSI has been collecting data on Detailed Digital Land Use Data since 1981 under a project of the Survey on the Trend of Housing Land Use, on which to prepare detailed information on present housing and possible future housing lots in the urban areas of Tokyo, Osaka and Nagoya.

10m grid base (mesh) land-use data taken during different periods, along with associated data, has been collected in order to classify and analyze the present and possible future state of change of housing land use.

c) Digital Cartographic Data from a 1:25,000 Scale Map

In 1984, the GSI started another digital map information collection project and has been collecting the data for fundamental categories of 1:25,000 scale cartographic maps, namely, contour lines, political boundaries, roads, railways and water edge lines.

The objective of the project is to prepare a digital cartographic data base from a 1:25,000 scale map for automated map compilation and production, and for dispensing and providing basic data of Geographic Information Systems, digital data services.

d) Digital Mapping

In Japan, the GSI, as well as private surveying companies, have been developing the technique of producing maps from aerial photograph by the digital process. With this effort, a manual for digital mapping standards focused mainly on large scale digital mapping, was proposed by the GSI in 1988. Since then, most large scale maps have been produced conformed to the proposed standard. The large scale digital maps of 900km² were

produced by digital mapping last year.

e) KDB

In Japan, digital map data have been produced and used in the field of urban planning, utility management, navigation, etc. by public organizations and private companies. Under these circumstances, the effective and proper use of survey data of digital maps is indispensable.

To avoid duplication and maintain accuracy, the GSI began the Kokudokihonzu (Japanese expression of National Large Scale Map) Data Base (KDB) project in 1989. In this project, the digital map data, scaled from 1:500 to 1:10,000, produced by basic or public survey will be stored in KDB and opened to the public.

f) Geographic Information Database

In 1990, the GSI started the preparation of "Geographic Information Database". The aim of this project is to construct a basic database of various kinds of geographic information and present it in various forms suited to wide-ranged users'needs, by applying the geographic information system. The skeletal structure of the database is the position and the place name of each geographic information on the digital base map which is digitized from 1:200,000 regional map series. This project is in the stage of system designing, and planned to work after 1992.

3. Thematic Mapping 1986 - 1990

The GSI is engaged in various kinds of thematic mapping in cooperation with other governmental organizations for the purpose of presenting basic geographic information for regional development, disaster prevention, etc. Table 5 shows some typical thematic maps prepared and published by the GSI during April 1986 - March 1990.

Table 5. Thematic Maps

Type of Map		Number of sheets
Land use map	1:25,000	14 sheets
Land condition map	1:25,000	13 sheets
Land condition map of coastal areas	1:25,000	5 sheets
Lake chart	1:10,000	6 sheets
Ground elevation map	1:10,000 - 1:50,000	3 sheets

Besides these maps, GSI has compiled various thematic maps as the results of the geographic researches, e.g. land condition maps of volcanoes, maps related to some

particular natural disaster.

4. The National Atlas of Japan

The first edition of the National Atlas of Japan compiled by the GSI was published in 1977 which has been widely acclaimed.

The GSI continued to revise this by using the latest statistics and other materials, and completed the National Atlas of Japan (Revised Edition), which was published on November 30, 1990. This A2-sized atlas consists of 218 pages and contains 235 thematic maps. About 40 % of the maps were prepared by a computer-assisted system. Both Japanese and English editions were prepared.

5. National Land Survey

The National Land Survey of Japan is being carried out under the direction and guidance of the National Land Agency (NLA). The objective of the survey is to contribute to the promotion of effective use and conservation of national land. To reveal the present condition of national land, such as land ownership and its'utilization, there is another objective to this survey. It is expected to be based on the National Land Survey Law which was enacted in 1951 when the survey was initiated. Three major items form the core of this survey; the cadastral survey, the land classification survey and the water use survey.

5.1 Cadastral Survey

The cadastral survey aims at clarifying the location, boundary, ownership, lot number, acreage, and current status of land use of each parcel. Local governments, such as prefectural and municipal governments, carry out the survey. They transact such affairs as planning the project, making a contract with a surveying company, and supervising. The NLA plays a role in the survey by giving local governments a 55 % subsidy on the total cost and also some technical guidance. The executive body only has to share 1/30th of the total cost, since a special grant is given to the survey by the Japanese government. Because of present austere budget conditions, we have suffered a sharp curb in the progress of the survey. 2,500 km² or more is the acreage that the cadastral survey has completed annually over the past five years. The progress of this survey at the end of F. Y. 1989 is as follows:

Completed cadastral survey; 98,543 km² (1951 - 1989)

Progress ratio ; 35.0 % (Target acreage of the survey; 285,500 km²)

The cadastral survey consists of the following stages; supplementary survey, detailed on-the-spot survey, measuring the acreage of each parcel, and making atlases and books.

The supplementary survey comprises the control point survey which is to set up control points for cadastral surveying. The establishment of these control points is carried out by the GSI. Scales of cadastral atlases differ from case to case depending on the mean acreage of a parcel. Scales of 1:250, 1:1,000, 1:2,500, or 1:5,000 are used. Of these, the scales of 1:500 and 1:1,000 are the most commonly used. The required accuracy of measurement is classified into six types depending on the land use pattern. For a residential area, as the example, the highest degree of accuracy is demanded. On the other hand, the accuracy level for a forest areas is the lowest.

Copies of cadastral maps and books are bound to be sent to registry offices after having been checked for accuracy and obtaining the legal approval of the National Land Survey, from the Minister of the National Land Agency, or, in some cases, from the prefectural governor, to replace the old maps which were prepared about 100 years ago, which are still used for levy and land registration.

The cadastral survey had not been promoted well, and in an attempt to do so, the acceleration law, named The National Land Survey Promotion Law was enacted in 1962. Under this law, a target acreage for the survey for a period of 10 years was clearly established. The survey is now proceeding into its fourth, Ten-year Plan stage (1990 - 1999). According to the plan, the target acreage is 49,200 km². For the more effective transaction of survey affairs, a personal computer system was introduced in 1984.

5.2 Land Classification Surveys and Water Use Surveys

A Land classification survey is the creation of a survey of topographical and geological features, soil, and present land use and the putting of the results into atlases and books. A water use survey aims at investigating the basic statistics of a river, such as annual rainfall, discharge, present water utilization for farming or drinking and ground water.

In the land classification survey, we have developed a computerized mapping method in which a specific device, controlled by a computer, and we can draw a colored map. By this method, one can easily identify various kinds of data related to land classification.

The above mentioned surveys are arranged into atlases and books as follows:

(a) Land classification maps (Geomorphological map, Surface geology map, Soil map, Present land use map, Land use capability classification map) overlays (such as slope classification) and an Explanatory Data book.

(b) Land conservation maps (Natural condition map, Present land use and vegetation map, Natural disasters map, Land use tendency and designated areas map, Control and designated area for disaster prevention map, Valuable natural and cultural assets distribution map, Basic conservation map) and Explanatory data book.

(c) Water use maps and a descriptive catalogue of available information on major river systems.

(d) Ground water data ledger

Table 5. Land Classification and Water Use Maps (1951 - 1989)

	scale	coverage
Land classification map	1:200,000	380,000 ㎢
	1: 50,000	241,000 ㎢
	1: 2,500 - 1: 5,000	4,370 ㎢
Land conservation map	1:200,000	118,400 ㎢
	1: 50,000	4,800 ㎢
Water use map	1: 50,000	72 river systems
	1: 25,000 - 1:50,000	2 regions

6. Soil Maps

Soil maps in Japan are roughly divided into two categories; cultivated lands and forest lands. They are prepared by the Ministry of Agriculture, Forestry and Fisheries.

A 1:50,000 scale map series of soil types and products of cultivated lands has been prepared by the Agricultural Administration Bureau since 1959, and the entire area of cultivated land, 51,000 km² in all, is coverd.

A 1:20,000 scale map series of soil types in national forests has been prepared by the Forestry Agency since 1947. 65,000 km² were covered by this series. This agency has also prepared a 1:50,000 scale map series of soil types for many private forests.

7. Geological Maps

Most of geological maps of Japan are published by the Geological Survey of Japan (GSJ), Agency of Industrial Science and Technology.

A series of basic geologic maps of 1:50,000 in scale after a series of 1:75,000 has been published since 1952 by the GSJ and the publication of 412 sheets, along with explanatory texts had been done until the end of 1989. The Japanese islands are coverd by 1267 sheet maps of 1:50,000 in which 811 sheet maps including those of 1:75,000 have been published. So, 64 % of the islands is covered by geologic maps in large scale. Fourteen compiled sheets of 1:200,000 in scale were published for four years from 1986 to 1989, two of which were revised editions. One compiled sheet of 1:500,000 in scale was published.

In addition to those geologic maps, various kinds of geological and geophysical maps are distributed by the GSJ, as follows:

(a) one computer-generated geologic map of Japan on the scale of 1:2,000,000.

(b) two hydrogeological maps on the scale of 1:50,000.

(c) seven marine geological and sedimentological maps on the scale of 1:200,000.

(d) three geological maps of volcanoes on the scale of 1:25,000, two of which are revised editions. In addition to those, a geologic map of Mt. Fuji was revised and eruption of Oshima island in 1986 was published.

(e) two neotectonic maps on the scale of 1:500,000.

(f) one geologic maps of oil and gas fields.

(g) one aeromagnetic map of Miyakojima island and its sounding area on the scale of 1: 200,000.

(h) one gravity map of north Honshu on the scale of 1:200,000.

(i) one geological map of geothermal area of northeast Honshu onthe scale of 1:100,000.

(j) geologic maps of Tama Hills, Tsukuba Science City and its surrounding area and Lake Biwa as special series of geologic maps.

8. Marine Geology

The GSJ has been engaged in marine geological and geophysical investigation of the seas surrounding the Japanese islands, the Central Pacific and the Antarctic, chartering the geological survey vessel Hakurei-maru (1821 gross tons) and other boats. The investigation comprises basic studies of marine geology, mineral resources and geophysical prospecting, and lacustrine and coastal sedimentological study.

Special efforts have been given to such research projects as pollution.

International cooperation is actively promoted in the fields of marine geology and mineral resources.

9. Hydrographic Work

9.1 Hydrographic Surveying and Charting

(1) The number of various hydrographic surveys carried out are as follows:

Type of survey	1986	1987	1988	1989
Harbour survey	10	10	9	7
Updating survey	220	209	222	217
Passage survey	0	0	1	2
Coastal survey	1	2	2	4
Oceanic survey	1	1	2	2
Survey for Basic Maps of the Sea	7	7	7	7
Survey for Earthquake Prediction	1	3	3	5

(2) The results of these surveys were used for production of nautical and other charts, as shown in the following table:

Type of chart		1986	1987	1988	1989
New charts	Nautical charts	12	11	8	10
	Miscellaneous charts	0	0	0	0
	Basic Maps of the Sea	29	34	28	20
	Aeronautical charts	1	0	0	0
New editions	Nautical charts	61	48	57	47
	Miscellaneous charts	2	5	2	15
	Basic Maps of the Sea	2	4	2	3
	Aeronautical charts	3	3	4	3
Reprints		13	7	11	8
Total		110	105	101	98

Note: The Basic Maps of the Sea (BMS) currently produced are classified as follows:

Series	Scale 1:	Coverage	Size	Type
BMS in Coastal Waters	10,000 50,000	Within 12M of the coast	Full	Bathymetry; submarine structure
BMS on Continental Shelf Areas	200,000	Continental margin	1/2	Bathymetry; submarine structure; total magnetic intensity; gravity anomaly
BMS in Ocean Areas	500,000	Ocean Area	Full	(Planned)

(3) The number of charts issued as of March 1989 is shown below:

Type of chart	Number of issues
Nautical charts	992
Miscellaneous charts	107
Basic Maps of the Sea	726
Aeronautical charts	25
Total	1,850

Note: The International Charts of the IHO under the responsibility of Japan as the producer nation, i.e. six of the 1:3,500,000 series and one of the two

1:10,000,000 series have been published.

9.2 Other Publication Activities

Type of publication			1986	1987	1988	1989
New publications	Sailing Directions (including Supplements)		1	3	2	1
	Special publications		21	20	20	20
New edition	Sailing Directions (including Supplements)		5	4	4	4
	Special publications		2	3	3	4
Notices to Mariners			3770	3457	3845	4442
Japan navigational warnings		(Japanese)	2135	1988	2063	2266
		(English)	974	638	679	799
NAVAREA XI navigational warnings			1338	1284	1301	1424
Information on Ocean Conditions	Quick Bulletin of Ocean Condition		24	24	24	24
	Ocean Current Forecasting		25	51	51	51

9.3 Oceanographic Activities

(1) Ocean Current Observation

The Hydrographic Department of Japan has been conducting a routine observation of ocean currents in adjacent seas of Japan by using survey vessels, patrol vessels and aircraft. Obtained data are compared with those from drifting buoys and the analytic results of infrared photographs taken from artificial satellites to be synthetically analyzed for the understanding of fluctuations in sea conditions.

(2) International Cooperative Research of Western Pacific Waters

The international cooperative research of the Western Pacific Waters (WESTPAC) is a regional project of the IOC, aiming to study and monitor variations of oceanographic structure, fluctuations in ocean living resources, etc. in the western Pacific, as well as to train personnel engaged in oceanographic activities in coastal countries of the western Pacific region. Japan has been participating in the project since the project was initiated.

(3) Sea Ice Observation

On the coast of the Sea of Okhotsk in Hokkaido and in waters to the West of Hokkaido, a great quantity of drift ice is a serious obstacle to navigation or fishery every winter.

In order to prevent marine accidents caused by drift ice, the Hydrographic Department of Japan has been observing the distribution and movement of drift ice by using aircraft and patrol vessels during the sea ice season which is from December to April every year.

(4) Observation of Tide, Coastal Currents and Tidal Streams

In order to obtain basic data for the safety of maritime traffic, utilization and development of coastal areas, determination of chart datum, prediction of earthquakes, and the like, the Hydrographic Department of Japan has been carrying out tide and tidal stream observations and ocean current observations.

(5) Survey of Marine Pollution

The Hydrographic Department of Japan regularly makes surveys of marine pollution in major bays, waters around Japan.

The Hydrographic Department has been conducting seawater sampling in areas around Japan twice a year (summer and winter). The sampling of seawater and sea-bed sediment are also made in A zones once a year to make an analysis for oil, PCBs (polychlorinated biphenyls), heavy metals, etc. According to the findings obtained so far, the pollution level was rather low in those sea areas and no progress in pollution has been observed in the last ten years.

In order to understand how discharged pollutants have spread from major bays to the ocean, the Hydrographic Department is conducting the sampling of seawater and sea-bed sediment in such bays as Tokyo Bay to make a chemical analysis for oil, COD, PCBs, heavy metals, etc. The results of observations revealed that the pollution level of seawater was rather low, while that of sea-bed sediment was slightly high in the inner part of such bays. In either case, however, the pollution level has shown no fluctuations in the last several years.

The Hydrographic Department has also been conducting surveys for artificial radioactive nuclides in seawater and sea-bed sediment in areas around Japan. After the Chernobyl reactor accident on April 26th 1986, the increase of caesium-137 in sea water, particularly in the Japan Sea, was observed. But in and after 1987, caesium-137 lowered to the same level as before the accident. According to the findings obtained so far, no progress in pollution has been observed.

9.4 Marine Survey For Delimitation of Sea Areas Under Japanese Jurisdictions

(1) Survey of Coastal Areas

In order to cope with the situation of extending the territorial seas to 12 miles, establishment of 200-mile exclusive economic zones (EEZ) and the necessity of delimitating sea areas falling under the Japanese jurisdiction by taking into account the adoption of the UN Law of the Sea Convention, the Hydrographic Department is carrying out detailed

surveys of low tidal lines, topography and geological structure of the sea-bed in coastal areas, particularly in those important areas around baselines defining the Japanese territorial sea.

(2) Survey of Continental Shelf Areas

The Hydrographic Department is carrying out hydrographic surveys south of Japan by using the large-type survey vessel "TAKUYO" equipped with modern survey instruments such as narrow multi-beam echo sounder in order to obtain basic data required for the promotion of utilization and development of the continental shelf areas of Japan.

(3) Promotion of Marine Geodetic Survey

Nautical charts of each country are constructed according to its own geodetic system. With the recent development of the geodetic satellite survey technique, however, a difference in geodetic systems becomes a problem. Accordingly, the IHO recommends that the meridians and parallels given on the chart should be shown on the basis of the World Geodetic System. Therefore, in Japan also, it becomes necessary to locate the mainland and remote islands on the basis of the World Geodetic System, and the Maritime Safety Agency has been conducting geodetic satellite observations by laser ranging to the geodetic satellite LAGEOS, in conjunction with the United States National Aeronautics and Space Administration (NASA) to obtain the precise location of the mainland on the basis of the World Geodetic System.

9.5 Realtime and Non-Realtime Information Supply Service

In order to disseminate information on matters required for the safety of ship traffic, Notices to Mariners are issued in printed matter, while the Japan Navigational Warnings and the navigational warnings (NAVAREA XI Navigational Warnings) by the Worldwide Navigational Warning System (WWNWS) are transmitted by radio.

In addition, information concerning the state of surface current, sea ice, etc. in the sea areas around Japan is supplied as 'Surface Current State of the Seas Adjacent to Nippon', to serve in the safety of sea traffic and economic operation of ships.

(1) Notices to Mariners

Notices to Mariners carry information for maintaining nautical charts up-to-date and information contributing to the safety of navigation and efficient operation of ships. The Notices are issued once a week. Information carried includes changes in aids to navigation, construction works at sea such as construction of Kansai International Airport, firing exercises conducted by the Defense Agency, etc.

(2) Navigational Warnings

a) Japanese Navigational Warnings are broad area navigational warnings, which are sent by radio thrice every day, giving emergency notices for the safety of navigation of Japanese ships navigating in the waters from the western part of the North Pacific Ocean to the Persian Gulf and foreign ships navigating around Japan. Since 1986, warnings particularly urgent among the navigational warnings are notified at any time without delay to improve realtime quality.

b) NAVAREA Warnings are a worldwide navigational warning system, and information on the waters for ocean-going ships is sent by radio through this system. The world sea area is divided into 16 areas and Japan is designated as Coordinator of the XI area (western part of the North Pacific Ocean and South-East Asian waters) to disseminate information as NAVAREA XI Warnings 4 times a day and also issue Weekly Summary of NAVAREA XI Warnings as printed matter.

Information requiring these navigational warnings includes submarine volcanic eruption, drifting of capsized ship, firing exercises, etc.

(3) Supply of Surface Current Information

a) 'Quick Bulletin of Ocean Conditions' is provided on the first and third Fridays every month, concerning the state of surface currents and sea ice of the seas adjacent to Japan by means of printed matter, facsimile or radio broadcast.

b) 'Ocean Current Forecasting' is supplied every Friday by means of facsimile illustrating the forecasted Kuroshio current and other main currents in the adjacent waters of Japan.

9.6 Provision and Supply of Marine Data and Information

Since the acquisition of marine data and information required for the utilization and development of the ocean costs much money and time, it should be further promoted to utilize such data and information not only for the primary purpose but also for the secondary and tertiary purposes. From this point of view, the Hydrographic Department has been engaged in collecting, managing and supplying such marine data and information for 25 years as a comprehensive marine data bank established in accordance with a resolution adopted by the intergovernmental Oceanographic Commission (IOC) of the UNESCO and a report made by the Oceanic Technology and Science Council of Japan. The Oceanographic Data and Information Division of the Hydrographic Department of Japan is registered as the Japan Oceanographic Data Center (JODC) at the IOC under the International Oceanographic Data Exchange (IODE) project promoted by the IOC, and is taking active part in internationally exchanging marine data and information for their effective utilization as the Japanese representative organization in the field of oceanographic data exchange.

10. International Activities

10.1 International Hydrographic Organization (IHO)

IHO Comissions, Committees and Working Groups in which Japan has been participating are as follows:

a) Finance Committee (FC)
b) Chart Standardization Committee (CSC)
c) Committee on Electronic Chart Display and Information Systems (COE)
d) Commission on Promulgation of Radio Navigational Warnings (CPRNW)
e) Committee on the Exchange of Digital Data (CEDD)
f) Working Group on Technical Aspects of the UN Law of the Sea Convention (TALOS WG)
g) Ad Hoc Working Group on the Revision of S.P. 23
h) FIG/IHO Technical Assistance Coordination Committee (TACC)
i) Working Group on Ocean Plotting Sheet
j) Working Group on Standards for the Release of Tidal Data to Commercial Organizations

10.2 Intergovernmental Oceanographic Commission of The UNESCO

The Hydrographic Department of Japan participates in international conferences held by the IOC as one of the Japanese technical organizations. The Oceanographic Data and Information Division (Japan Oceanographic Data Center (JODC)) of the Department is designated as a Japanese representative organization in the field of the exchange of oceanic information, and is also in charge of the Responsible National Oceanographic Data Center (RNODC), which manages the data from international projects such as the IOC Sub-commission for the WESTPAC programme and Joint IOC-WMO Working Committee for Integrated Global Ocean Services System (IGOSS) programme.

10.3 International Lunar Occultation Center

The Hydrographic Department conducts astronomical observation under the international cooperation and makes efforts to improve the accuracy of such almanacs as ephemeris. Particularly from April 1981, upon the request of the International Astronomical Union (IAU), the Department took over the activities performed by the Royal Greenwich Observatory as the International Lunar Occultation Center and started to collect and analyze observations about occultation obtained all over the world in a homogeneous manner.

10.4 Japan-China Joint Research of The Kuroshio

The Hydrographic Department of Japan has been carrying out observations of and doing research on the changing mechanism of the Kuroshio in cooperation with researchers and scientists from China. As part of Japan-China Joint Research of the Kuroshio, the Department has been carrying out observations of the Kuroshio in the East China Sea and southern seas of Honsyu since 1986. The observations were carried out for the purpose of clarifying the characteristics of the Kuroshio and its flows in the Tokara Strait, as well as the process of originating the Tsushima Warm Current. Survey vessels are used once in every season a year (4 times), and more than 10 observation lines are set, and mooring arrays are deployed to obtain long-term consecutive data in these areas. The flow of Kuroshio is tracked by using satellite-tracked drifting buoys (ARGOS).

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TWELFTH UNITED NATIONS REGIONAL CARTOGRAPHIC
CONFERENCE FOR ASIA AND THE PACIFIC
Bangkok, 20-28 February 1991
Item 5 (a) of the provisional agenda*

CARTOGRAPHIC DATA ACQUISITION AND SUPPORTING ACTIVITIES: CONVENTIONAL AND SATELLITE GEODESY

Establishment of marine geodetic controls and the world geodetic system

Paper submitted by the Hydrographic Department,
Government of Japan

* E/CONF.83/1.

1. World Geodetic System and Nautical Charts

With the recent development of global satellite navigation systems which provide us with precise positioning techniques all over the world, IHO adopted some technical resolutions (TR) on the geodetic reference system of nautical charts. The resolutions concerned stipulate that (1) nautical charts should be based principally on the world geodetic system (WGS), which is realized by the current satellite navigation systems, i.e. NNSS and GPS (TR B1.1), and (2) when the conventional regional geodetic reference system is adopted for nautical charts, some comments on conversion values should be given on the charts of reduced scale larger than 1/500,000 (TR B2.10). These conversion values are to be added to the positions derived from satellite navigation systems on the world geodetic system, in order to plot the positions on the relevant charts.

The Hydrographic Department of Japan (JHD) has been giving such comments on conversion values between the world geodetic system and the Japanese geodetic system on the charts recently published or revised in accordance with the IHO resolutions mentioned above. These works are based on the results of precise geodetic observations made by JHD using techniques of satellite geodesy.

The determination of the relation between the regional geodetic system, which is adopted as the geodetic reference system of the nautical chart, and the world geodetic system plays important roles not only for a safe navigation with modern navigation systems but also for the circumstances under the newly-agreed UN Convention on the Law of the Sea. Especially, since it is necessary to clarify the relation between geodetic reference systems of the neighboring countries in order to establish median lines between countries, precise positioning of the territorial lands/islands on the world geodetic system is very important and the techniques of such positioning should be developed.

2. The Marine Geodetic Controls of Japan

(1) Use of Satellite Laser Ranging Technique

JHD is conducting geodetic surveys for the precise determination of the main lands of Japan and her smaller islands with reference to the world geodetic system for the purpose of making accurate charts, which is necessary not only for safe navigation but also for delineating the waters under the nation's jurisdiction and median lines between those of its neighboring countries under the circumstances of the new Law of the Sea.

A fixed satellite laser ranging (SLR) station was installed at the Simosato Hydrographic Observatory (SHO) located at Simosato, Wakayama Prefecture, in 1982. The station has been operated in order to make clear the relation between the Japanese geodetic system and the world geodetic system. The SLR observations of geodetic satellites such as LAGEOS, a U.S. geodetic satellite, have been made in cooperation with the world SLR stations. SHO acts as the fundamental fiducial point in the marine geodetic controls around Japan, and as one of the most important SLR stations in the western Pacific area among the world SLR network.

JHD developed a new program for processing/analyzing satellite orbit by using SLR data. The program is named "HYDRANGEA" , the **HY**drographic **D**epartment **RANGE** data **A**nalyzer (Sasaki, 1990). The SLR data taken at SHO and world SLR stations are analyzed by HYDRANGEA, and the position of the fiducial point at SHO is located precisely in the world geodetic system. Consequently the Japanese geodetic reference system, the Tokyo Datum, is connected to the world geodetic system. The present values of the transformation parameters in the geocentric coordinate system from the Tokyo datum to the world geodetic system derived from SLR data are as follows:

DU=-146m, DV=508m, DW=682m.

The SLR data are used for computing precise baseline length between world SLR stations which are located on different plates, and change of the baseline length imply the relative motion between plates. Some results of changes of baseline lengths derived from SLR data for five years computed by using HYDRANGEA are as follows (Fig. 1):

Simosato (Eurasia plate)	-	Quincy,USA (N.America Plate)	-11(-19) mm/y
Simosato	-	Monument Pk.,USA(Pacific)	-57(-64)
Simosato	-	Hawaii,USA (Pacific)	-119(-99)
Simosato	-	Wettzell,FRG (Eurasia)	-31(0)
Simosato	-	Yaragadee,AUS (Indian)	-62(-77)

*the numbers in the parentheses are those geologically estimated by AM0-2 of Minster and Jordan (1978)

A mobile SLR station named HTLRS, the **H**ydrographic Department **T**ransportable **L**aser **R**anging Station, whose specifications are given in Table 1, was constructed in order to connect major islands to the SHO station, the main land of Japan, by using the Japanese geodetic satellite, AJISAI, which was launched in August, 1986. The system of the HTLRS is housed in two shelters (Fig. 2). The mobile SLR station is transported by a surface ship or a cargo airplane to the major islands, called first order control points. AJISAI is observed simultaneously by the fixed SLR station at Simosato and the mobile SLR station located at an island, and then the relative position of the island to SHO is determined. The HTLRS was transported to several isolated major islands (Fig. 3), and the relative positions of the islands to the fiducial point at SHO were determined. Especially, the baseline length between each island and SHO was determined very precisely within an accuracy of a few centimeters. These results are useful for the detection of plate motions and inner plate deformations by repeat observations.

Table 1. Specifications of the HTLRS

Subsystem	Specification
Laser	Nd:YAG,50mJ,100ps pulse width,5pps
Mount	elevation over azimuth, Coude path
Transmitter/Receiver	a common flat plate for elevation
	10cm diameter for transmitter
	35cm diameter for receiver
Receiving electronics	Micro-Channel-Plate PMT
	20ps resolution
Mount control	DC servo
	torque motor/tachometer/encoder
Clock/Frequency standard	Rubidium oscillator calibrated by
	multi-Loran C waves and GPS
Meteorological sensors	temperature, humidity, pressure
	wind speed/direction
Shelters	2 shelters, 2.1x2.3x3.5m and
	2.1x2.3x3.8m, air conditioners
Power generator	20kw for AC 200V, 7.5kw for AC 100V

(2) Use of Satellite Navigation Systems by their Geodetic Applications

The geodetic use of NNSS by means of simultaneous observations is applied for the connection of secondary islands, called second order control points, to the first order control points. The translocation technique is employed in this case. More than 30 islands were connected to the first order control points by this technique.

A new satellite navigation system, GPS, is being established by U.S.A. The application of GPS to geodetic observations is performed by simultaneous observations for several hours with two or more GPS receivers in the differential mode, and the positions of the receivers are determined relative to the reference receiver located at a fiducial point whose precise position is known beforehand. The simultaneous observation is repeated several times, and the results are averaged to

obtain the most reliable data. This technique is becoming one of the effective geodetic positioning techniques, and it will be able to be used for our project of constructing the marine geodetic controls of Japan. The special application of GPS to a very precise observation of baseline length in the differential mode is employed to try to detect local crustal deformations in the active areas of earthquakes and volcanos.

3. Cooperation in the Satellite Geodesy Geodesy

The application of satellite techniques to worldwide geodetic observations is indispensable and very effective. The world geodetic system is defined by the result of these observations under the cooperation among worldwide observation stations. The establishment of a precise geodetic reference system is important in the global earth sciences such as researches on the rotation and the orientation of the earth, plate motions, earth interior, global ocean dynamics and earth's environment. The determination of the relation between the geodetic reference system of each country and the world geodetic system is necessary to make a unified geodetic system for a safe navigation with precise worldwide navigation systems and for the new circumstances under the Low of the Sea.

The international cooperation in this field is necessary naturally, and the cooperation can be made in exchange of technical information on precise geodetic surveys by means of satellite geodesy, exchange of persons to learn and research on satellite geodesy, carrying out cooperative observations in the Pacific region by using GPS techniques and developing advanced geodetic satellite techniques. The first step of the cooperation may be to exchange information on the geodetic reference systems on which nautical charts of respective countries are based.

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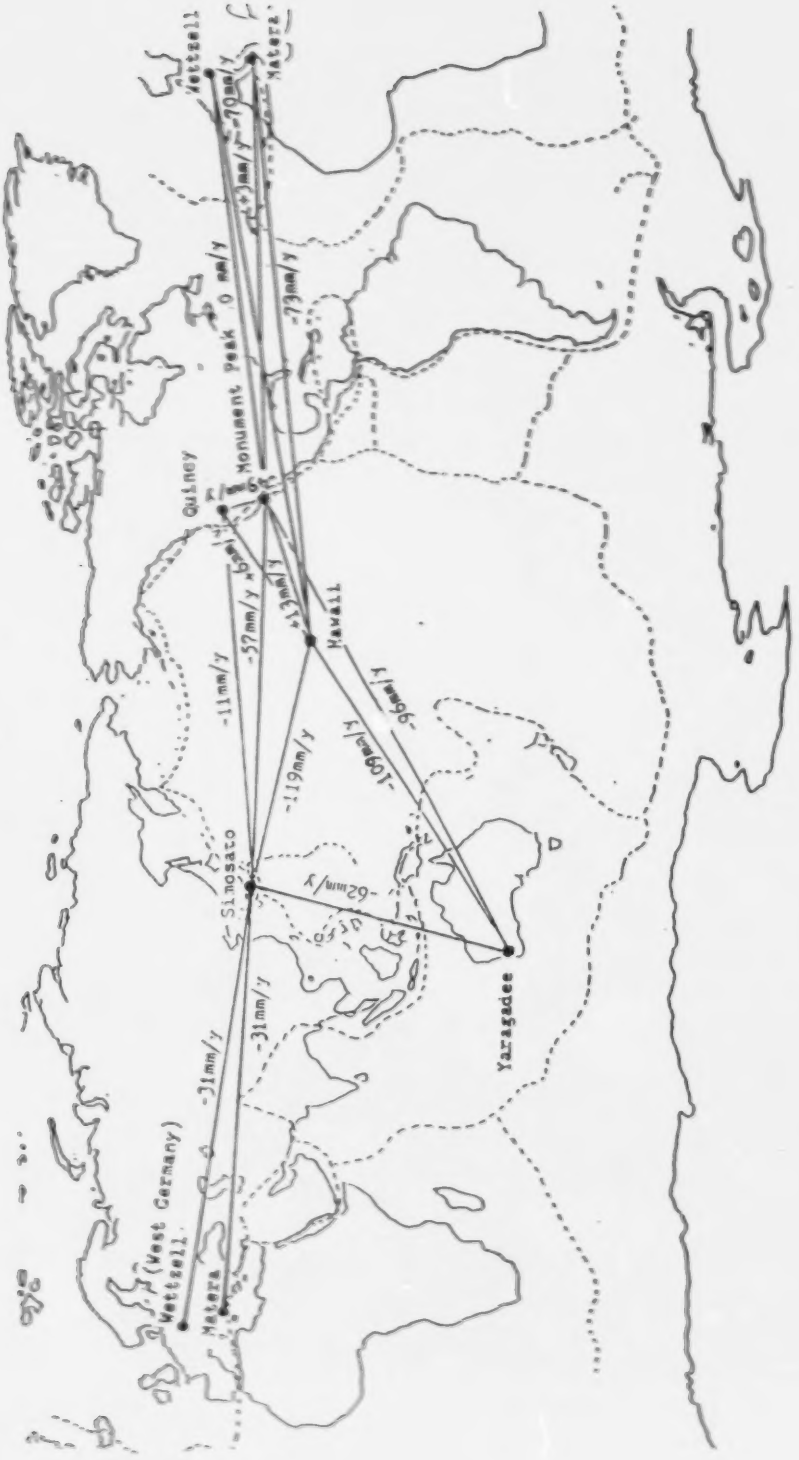

Fig.1. Worldwide plate motions derived from LAGEOS SLR data computed HYDRANGEA.

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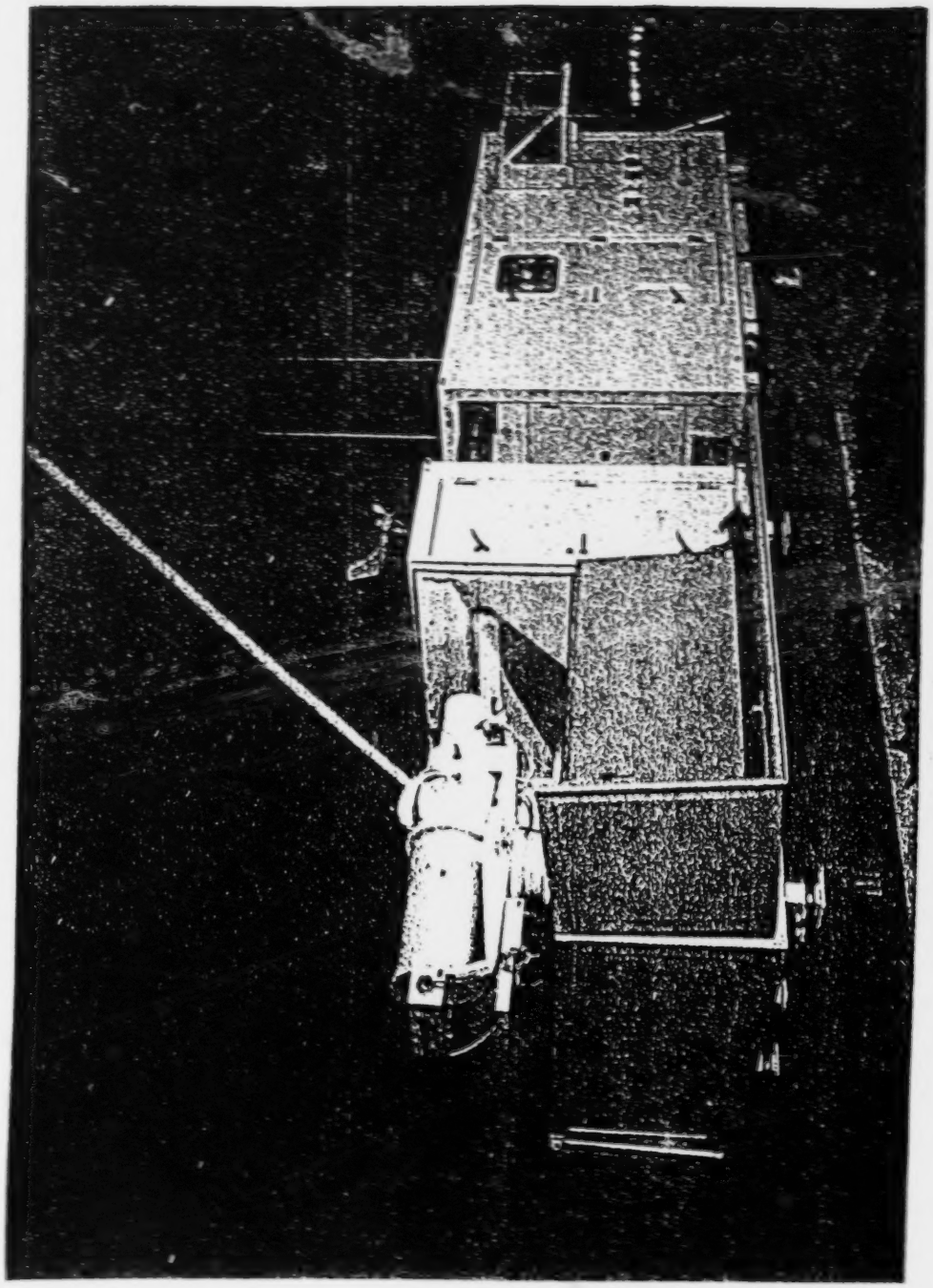

Fig.2. The mobile SLR station "HTLRS".

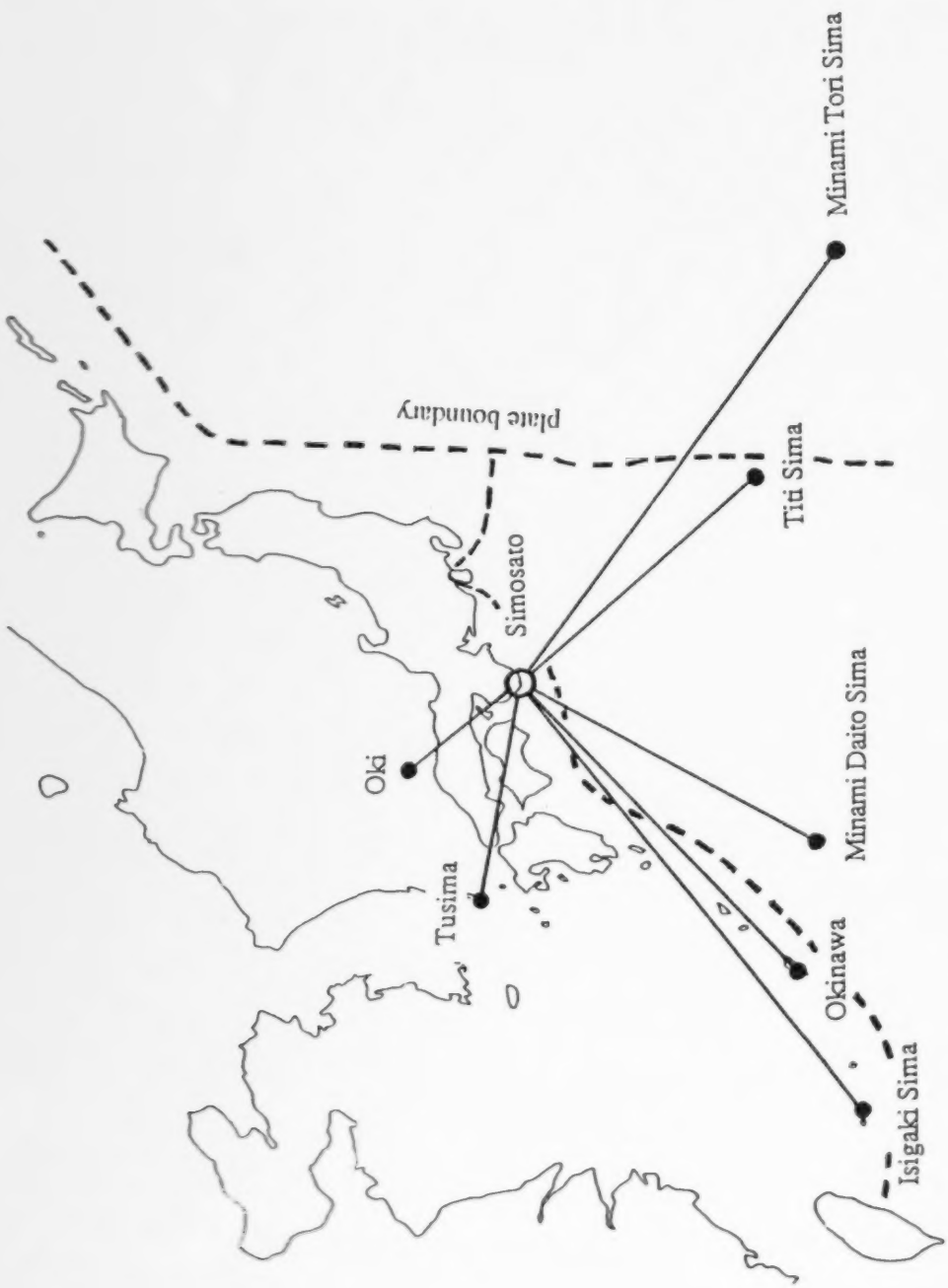

Fig.3. First order fiducial points connected to Simosato by SLR observations since 1987.

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CARTOGRAPHIC DATA RECORDING COMPILATION AND MANIPULATION: SPECIAL MAPPING (INCLUDING MAPPING FOR THE HANDICAPPED AND THE INTERNATIONAL MAP OF THE WORLD ON THE MILLIONTH SCALE (IMW))

Preparation of the National Atlas of Japan, revised edition

Paper submitted by Japan

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* E/CONF.83/1.

I. Introduction

A five-year project was initiated by the Geographical Survey Institute in 1986 for the revision of the National Atlas of Japan. The revised edition of the National Atlas was published in November 1990. This paper contains an outline and description of the project.

Upon publishing "The National Atlas of Japan", which was our first one, it spread and was put to practical use in many fields, such as government, local governments, private companies and educational organizations. But after 10 years, economic and social situations had changed greatly. In the "International Age", so to speak, the relationship between foreign countries has become more significant, and with recent progress in the information society, map information has risen in importance more than ever. For these reasons, every kind of thematic maps, which was included in the first edition, was requested to be renewed.

The National Atlas of Japan, revised edition was based on every kind of reliable data which totaled to 235 thematic maps and its explanations. Those thematic maps was comprised of 14 fields such as physical features, climate, land development and conservation, population, social conditions, education and culture.

II Outline of the project

① Basic policy

(1) It aimed at the reduction of labor and promotion of efficiency by the technique of compilation of photoengraving film and graphics by the introduction of a computer mapping system.

(2) We made it so as to be able to compare it with the first edition.

(3) We investigated the scale of the base map, and the expression.

(4) In order to meet the needs of times, we reconsidered maps found in the first edition and added new thematic maps and statistical graphs.

② Working contents

5 years (since 1986 to 1990)

③ Book format of The National Atlas of Japan

(1) Size: A2 size(60×46cm)

(2) Pages: 218 pages

(3) Scale: 1:2,500,000 ～1:16,000,000

(4) Colors: 5～12 colors (average 7 colors)

(5) Languages: Japanese and English version

(6) Breakdown of thematic maps: as follows

Items	The National Atlas of Japan published 1977	The National Atlas of Japan Revised Edit. published 1990
	the number of thematic maps (the number of pages)	the number of thematic maps (the number of pages)
General maps	2 (4)	2 (4)
Physical features	30 (40)	28 (32)
Climate	29 (28)	29 (20)
Land development and Conservation	15 (20)	11 (16)
Population	21 (28)	27 (20)
Agriculture, Forestry and Fisheries	31 (44)	27 (20)
Mining, Manufacturing and Construction	26 (38)	23 (20)
Transport and Communications	29 (40)	16 (16)
Foreign trade and Flow of goods	10 (12)	4 (4)
Commerce, Banking and Insurance	12 (16)	11 (8)

Politics and Finance	8 (8)	10 (8)
Social conditions	26 (28)	22 (20)
Education and Culture	29 (32)	24 (20)
Regional maps	7 (10)	———
Administrative	1 (3)	1 (3)

III Circumstances leading to preparation

The Geographical Survey Institute compiled 1:8,000,000 scale geographical maps, which could be considered as the offshoot of a national atlas of Japan from 1946 through 1960. But it was not binded as an atlas. In 1948, the atlas "Japan" was published. This atlas was a booklet which consisted of 1:2,000,000 scale maps with geographical notes. The book turned out to be the product of an elementary research work oriented toward the compilation of a genuine national atlas.

In 1971, the Program for the Compilation of a National Atlas of Japan was approved as an official project endorsed with a national budget, and the project was started as a 5-year program. The project was based on deliberations by the Committee for the National Atlas of Japan, and a national atlas entitled "The National Atlas of Japan" was published in March, 1977.

This was an A2-sized atlas of 351 pages containing 276 thematic maps and their descriptions in 15 different fields such as physical features, development and land

conservation, social condition and culture, and has been utilized as basic data for a true understanding of the state of Japan ever since. Later, in the process of revising the thematic maps contained in "The National Atlas of Japan", the Geographical Survey Institute and the Committee proposed the idea of creating a thematic atlas containing maps on particular themes, and a new project with regional planning as its theme was started in 1979. This atlas was completed in September, 1984 and published under the title of "The Atlas for Regional Planning - Actual Conditions and Changing Aspects of the National Land in Japan".

Before the actual revisional work, the principal policy with regard to the whole plan was presented through the discussion by the Committee of the National Atlas. In November, 1990, it was named "The National Atlas of Japan, Revised Edition" and published.

Ⅳ The actual compiling work

① Establishment of the Committee of the National Atlas of Japan

The revisional work was conducted under the Committee of the National Atlas of Japan in order to both smooth the progress of this project and substantiate its contents. This committee insisted on two organizations; one a committee which discussed the project plan and the state of progression, and other a special committee which discussed the examination of each theme separately, such as nature, social condition, economics, etc.

In this committee, the under secretary of construction was the chairman and it

consisted of members and special members of related 20 government agencies and scholars. They decided on the basic policy of revision work based on the discussions.

② Data collection

Before the compilation of the thematic maps, most data collections were conducted at many public enterprises such as the central government agencies and public corporations. Such surveys, were done directly by the researchers, and often transcribed or took a copy of necessary data collected according to circumstances. In surveys related to nature subjects, which required special technical knowledge, we were orally helped by scholars or experts in that particular fields.

③ Data analysis

Attained data were then taken to analysis work. Analysis work consisted of judgements on whether the data could be available or not, estimatation of whether it was able to indicate analysed data in an expected method, and then workers were advised about calculation process, etc.

④ Making of editorial rule

After ratio calculation of each area to compile a colopleth map, various rules (editorial rule) on actually compiling the maps were decided, for example, statistical class mark by investigating frequency of statistical value, while exchanging views with the Committee of the National Atlas of Japan.

⑤ Editorial work ~Cartography ~ Film making

The compiling process of the map which use products from former steps, was carried out mainly by computer operation. On the other hand, thematic maps compiled with traditional technique were related to nature or climate which was comparatively difficult to deal with the computer process.

⑥ Test printing

We checked the actual maps, and mainly concerned with color design.

⑦ Printing / Bookbinding

V Thematic map compiling founded in National Atlas by CCPS

On compiling the National Atlas of Japan, Revised Edition by CCPS(Computer-aided Cartographic Processing System), we first discussed about the presentation of it. It was finally decided that 60% of the whole presentation were to be statical graphic charts, such as colopleth, circle symbol and formation of unit symbol or maps representing distribution of themes with its scope demarcated such as climate chart. Therefore we used existing softwares to present the persentations easily. Meanwhile, we have appended and replaced software corresponding to the compiling of the National Atlas.

① Input / edit

(a) Compiling of base map

In our compiling work of the atlas, we kept every scale in repair with due regard to frequency of utilization. The working proccess is as follows;

(1) Paste up base map film on drum scanner, scan it by sampling pitch 50μm, 4 revolutions/minute.

(2) The figures are recognized as lines(ruster data), therefore vectorize and thin them.

(3) Process data which is diplayed on CRT by dialogue operation; for example line correction, attribute bestowal, formalization and so on.

(4) In compiling the colopleth map, convert the file which was made at (3) to polygon data, and put code of administrative districts.

(5) Lay out base map in A2 size unit to avoid extra work when it is output.

(b) Compiling of colopleth map

We input statistical data from the keyboard or magnetic tape, analyzed data, ranked it and made a ranking file for the colopleth map. We then match it to the polygon data file which was maintained in compile process of base map, and a colopleth map for municipals of prefectures was compiled.

(c) Compiling map with circle graph

The map with circle graphs was made by inputting statistical data, and then by calculation and analyzation, the compiling was done.

Working process is as follows;

(1) Using the vector data compiled at (a) background map (base map), the center of each

prefecture was indicated by a cursor on the CRT, and then the file for the center position (X,Y) of the circles was generated.

(2) By matching the parameter file (which includes the formula of the radius and the number of items) and the data necessary for drawing the circle graph, and also the center position file compiled at (1), the circle graph was drawn on the CRT. If a circle should fall on one anoter, they can be moved to a suitable position, so that the map with a circle graph are laid out appropriately and can be compiled.

(d) Compiling of maps representing distribution theme with its scope demarcated

This map is compiled by a computer process where the original picture which drawn by a scanner is input. There are some methods of input. They are methods by indication of color points, by region-painting, by symbol recognition and so on. They are different in recognition of colors in closed regions. The method of indication of color point is as follows;

(1) Trace out necessary boundary line on a polyester film from original pictures. Put color in the center of the closed region which is contained by boundary line.

(2) Input pictures made at (1) by using scanner and distinguish automatically the colors. Now it can distinguish 16 colors on a personal computer system.

(3) Closed regions which cannot distinguish colors because of its small area or so on were corrected by dialogue operation.

(e) Compilation of distribution map

The distribution maps which for example show positions of public facilities, were compiled from partly processed or corrected existing data, such as digital national land

information, and were output by laser printer, etc. In those maps, if it became very complicated because of the large number of points for its scale, we introduced the method of manual editing and draft a map which indicated the positions output from XY-plotters or so on.

② Regulation of files

In cases where input and edit was performed on a computer system, many data files were generated, therefore the National Atlas of Japan, Revised Edition files are classified into base maps, legends, circle graphs, colopleths and final products. Furthermore, we regulated each thematic map.

③ Output

Data output to ink jet printer, electostatic plotter, laser plotter, etc. are limited to ruster form. So vector data must be convert to ruster form. Though data inspection is unnecessary on CRT, a vector data designated ranking and color directly so as to be able to output without the image of ruster data. In this case, the file for output can be stored, and have introduced this method for output.

About the time which is spent for the compiling process, it took about 2 hours to compile file for output in sampling pitch 50μm and A1 sized both base map and thematic map. Two hours and 30 minutes is necessary to draw on film by a laser plotter.

VI Future view and problems

① Technical problem for CCPS utilization

As for the National Atlas Revised Edition, 60 % of the thematic maps were compiled by CCPS utilization, including manual work.

As a result, simplification of the working process, shortening of working time and cost reduction as compared to the traditional manual technique were confirmed. Therefore, with respect to doing same types work in other projects, this impact on a technical level is very large. Although the thematic maps dealt in the National Atlas are numerous and varied, there are few technical and accuracy problems in its processing. Thus, it was easier to carry out the work. However, there remains some problems of computerization of the whole work which needs to be resolved.

The maps which are compiled by CCPS are mainly present with colopleth and circle graph. For the thematic maps, which are comparatively hard to deal with a computer system, we will have to think of a better method to compile them smoothly.

The process assisted by a computer system is performed by a "dialogue" operation with the computer system. For the future, we also think that a study is necessary to compile full-automatically.

② Modification plan of thematic map

As for revision of the National Atlas, the whole atlas was traditionally revised. But now, social needs about information are that one should offer new information quickly in every thematic map. After this, we will prepare so that we can modify main

thematic maps more quickly. That plan is concerned with designating statistics (whose data are cyclic replaced), which is especially much in demand, and to renew thematic map in real time and offer latest information to users quickly.

③ Conversion to electorical medium

Recently in Japan, various kinds of "New Medium" has been developed and goods are available at low cost. In former days, computerized information was mainly used by enterprises. Now, it is necessary to offer information and to take a serious view of indivisual utilization such as personal computers and word processers, etc.

Therefore in the Geographical Survey Institute, it has promised on a new electorized the National Atlas in fiscal 1990. In order to carry out this plan, actual work has begun. This plan is to offer CD-ROM included of electorical map data with software which enables processing and editing of the original data.

④ With regard to desirable direction of the National Atlas

In compiling an atlas, it is necessary to discuss an actual counterplan on what atlas users will further expect. To immediately accomodate this information oriented society, we think it is necessary to combine with every data, which belongs to each government agency, the online information processing system, and to offer latest information as maps or in an electorical information form to the users.

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CARTOGRAPHIC DATA RETRIEVAL, ANALYSIS, DEPICTION, PRESENTATION AND PRODUCT GENERATION: DIGITAL DATA BASES

Standard procedure and data format for digital mapping

Paper submitted by Japan

* E/CONF.83/1.

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1. Introduction

The Geographical Survey Institute (GSI) of Japan gathered most of the Japanese aerosurvey companies involved in the research and business of digital mapping to establish a Japanese standard in 1984. In the mean time, GSI set up a committee composed of scholars and experts to discuss and investigate the standard. GSI and the committee proposed the draft standard, focusing mainly on large-scale digital mapping with a photogrammetric process, in March 1988.

The principles of standard ensures true position data without any replacement or deleting, data flexibility to meet user requirements, simplicity of data format to ensure applicability to any user system and completeness of the general cartographic information set.

Computer mapping technology including computer assisted map making, digital cartographic data creation and geographical information management is getting more and more popular in Japan in these few years. Especially, "Digital Mapping" technology, which is to create digital cartographic data through photogrammetric processes, has rapidly become the center of attention of local governments and public utility enterprises, because of its high accuracy and usefulness in true position data.

In order to take full advantage of this technology and to bring it into wider use, it isessential to standardize the procedure and data format. In this regard, the Geographical Survey Institute (GSI) gathered most of all Japanese aerosurvey companies involved/interested in research and business of digital mapping technology to establish a Japanese standard in 1984. In the mean time, the GSI set up the committee composed of scholars and experts in the field of photogrammetry, computer mapping and municipal administration to discuss and investigate the standard.

Through one year of preparatory study and three years of investigation, the GSI and the committee made the draft standard in March 1988, which is now under the process of authorization.

This paper describes the principles and abstract of the standard.

2. Current Situation of Digital Mapping in Japan

The whole world of computer mapping can be divided into three stages, namely data creation, circulation of data set and data utilization. The data creation stage can be subdivided into two different techniques. They are the digitization of printed maps and digital mapping.

In Japan, middle scale maps of 1:25,000 have been prepared by the GSI and revised every three to ten years covering all of Japan as the national base maps. Digital cartographic data corresponding to those scales are expected to be prepared by a map digitization method rather than digital mapping and have been partially digitized by the GSI and other organizations.

On the other hand, larger scale mapping of 1:500, 1:1,000, 1:2,500, 1:5,000 or others are mainly prepared by local governments for urban planning, public works inventory, utility management and so on. Digitization of those maps are much focused on the geographical information system. Because of the requirement of high accuracy and data freshness, digital mapping technology is supposed to be very suitable for the creation of digital cartographic data for those scales.

The procedure and specification of digital mapping should be standardized in order to guarantee data accuracy and compatibility so that the data can be utilized by other parties as well. The GSI considered that it is responsibility of the GSI to help the digital mapping community establish the Japanese standard for the procedure and compatible data format.

Before we started this study, some municipalities and public utility enterprises together with some leading aerosurvey companies prepared digital cartographic data with no compatibility, and this situation seemed to expand year by year. Therefore, in consideration of this urgency, the first draft was issued in March 1986 and the final draft was made in March 1988.

3. Principles of the Standard

Digital mapping technology is not only a method to create digital cartographic data, but also photogrammetric surveying and mapping. In this regard, the standardization is focused not only on data format and data code systems corresponding to each cartographic entities, but also on the procedure and the specification of digital photogrammetric processes. Regarding the photogrammetric processes, attention was paid to assure surveying accuracy which was prescribed in certain rules and regulations as for corresponding scale maps. On the other hand, data codes and formats are to be standardized from the viewpoint of data compatibility and data usability in various geographical information systems. The principles of the standardization are as follows.

(1) Purpose of digital mapping

The main purpose of digital mapping is considered to be the creation of digital cartographic data for various geographical information systems. In this regard, digital

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data set obtained through digital mapping should meet the following requirements.

a) Assurance of true position data without any replacement or deletion which come from the limitation of map drawing capability.
b) Data flexibility which enables to meet various user objectives.
c) Simplicity of data format to assure the applicability to any user system.
d) Completeness as the general cartographic information set.

(2) Documents of the standard

Contents of the standard were described in the following seven documents.

a) Standard Procedure of Digital Mapping
b) Code System for Digital Cartographic Information
c) Data Format of Standard Exchange File
d) Manual of Data Acquisition Specification
e) Recommended Map Drawing Standard
f) Related File Format and Specification
g) Quality Control Manual of Digital Mapping

(3) Standard Exchange File

There can be so many files created and used in computer mapping. However, most of them are only temporal or unique to a specific application, and to which standardization is unnecessary and useless. Here, only the "true position data file" was strictly standardized to guarantee the compatibility. In addition, recommended standards were shown for mapping (drawing) data file and structurized data file.

4. Standard Procedure of Digital Mapping

Standard Processes are determined as follows.

a) Planning and Preparation
b) Control Point Survey
c) Anti-airphoto Signal Setting
d) Aerial Photographing
e) Pricking
f) Field Affirmation
g) Aerial Triangulation
h) Digital Data Acquisition through Stereo Plotting

i) Field Terrain Survey
j) Data Edition and Compilation
k) Supplemental Field Survey
l) Creation of Standard Exchange File
m) Revision of Standard Exchange File
n) Arrangement of Results and Products

The following processes are determined to be optional.

a) Creation of Data Management File
b) Drawing out Maps
c) Creation of Structurized Data File

Processes from "Control Point Survey" to "Aerial Triangulation" were standardized just as same as the conventional photogrammetric mapping processes. "Digital Data Acquisition through Stereo Plotter" is performed by using either analytical plotter or analogue stereo plotter with encoding capability. Data should be monitored simultaneously by either a graphic display or drawing table during the data acquisition stage simultaneously. Terrain information can be created by any of the following three methods. They are the methods 1) to obtain digital contour line data, 2) to obtain grided digital elevation data and 3) to draw contour lines on a paper and then digitize them.

5. Code System for Digital Cartographic Information

In order to identify each cartographic entity, ten digit integer composed of two digit"layer code", two digit "data item code", two digit "area code" and four digit "informationcode" were prepared. Layer code and data item code are strictly standardized, while area code and information code are optional. Area code is to be used to express locational or topological information. Information code is to be used to subdivide or dual classify data item code.

Standardized "layer code" are as follows.

Code	Layer
11	boundary
21	road
22	road facility
23	railway
24	railway facility
30	unclassified building
41	public utility facility
42	other small objects
51	water front
52	water facility
61	wall, fence etc.
62	special field

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31	lower building	63	vegetation
32	higher building	71	contour
33	building without wall	72	scarp
34	building belongings	73	control point
35	building use	75	DEM
		81	text

6. Data Format of Standard Exchange File

Figure-1 shows the generalized data structure. Hierarchical structure with any depth of levels were adopted. There are six record types defined as follows. All records are fixed length of 84 bytes in ASCII/JIS characters.

(1) Index Record

As a header of one complete digital cartographic data set, this record describes the information of contents and is recorded on an independent file.

(2) Map Marginal Unit Record

The data set is to be divided by appropriate units usually corresponding to conventional map sheets, so that we can avoid the decrease of usability caused by the huge quantity of data. Each unit is stored in one file. The map marginal unit record contains the information of each unit such as the name of the area, geodetic coordinates of the unit origin, date of data creation, revision etc. and recorded at the top of the file.

(3) Group Header Record

In the hierarchical structure, each element corresponding to the individual cartographic entity can be grouped. Moreover, elements, group of elements and group of groups can be grouped. This group header record describes the information on how the group is composed. At level one, shown in figure-1, each group corresponds to each layer.

(4) Grid Header Record

Most of the digital mapping data are composed of points and sequence of points (so called vector data). Besides, there can be grided data as digital elevation model data. Grid header record is a record to describe the grid origin, interval, size, etc. and followed by substantial grided data records.

(5) Element Record

This record is the lowest level header record corresponding to individual cartographic entity which is expressed by one type of substantial data records. This record is

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followed by substantial data records.

(6) Substantial Data Record

This record describes real geo-coordinates, text or attributes. There are five types of formats corresponding to three dimensional coordinates, two dimensional coordinates, text,attribute and grided data.

7. Principles of Map Drawing

The main purpose of digital mapping is to create digital cartographic data for various geographical information systems. However, drawn or printed maps are often still used in many ways. In this study, map drawing procedures and specification were not to be strictly standardized, but recommendations were shown.

Since the standard exchange data file are composed of true position data, it would be rather difficult to read the map directly drawn from the data. In order to improve the readability of a drawn map, it is necessary to edit or compile the data from the viewpoint of map presentation capability. In this recommendation, most attention was paid to performance rather than to automatic editing, manual/interactive editing, to improve cost benefit trade off. This direction may reduce map quality. However, map output is considered to be a secondary product in digital mapping, and so, this reduction of map quality is supposed to be allowed.

8. Structurized Data File

The standard exchange data file contains digital cartographic data with classification code recorded on standard file format. However, for advanced utilization of data as in a geographical information system, it is necessary that some data are to be topologically structured. Structurized data are created for individual geographical information systems and usually not expected to be exchanged between different systems. Therefore, the structurized data file was considered out of standardization, and only recommendations were shown.

In the recommendation five standard geometric models are proposed and twelve file formats are invented for structurizing all structural bodies. By combining five standard geometric models, any structural body can be structurized.

The standard geometric models are as follows.

a) Individual point model
b) Individual line model
c) Individual plane model

d) Network model

e) Area divided model

The twelve files are as follows.

a) Index file

b) Structurized file

c) Point file

d) Line file

e) Plane file

f) Plane definition file

g) Standard phase file

h) Extended phase file

i) External identifier file

j) Digital mapping attribute file

k) User attribute file

l) Correspondence file to Standard Exchange File

9. Conclusion

Digital mapping is a relatively young technology and is still being developed. The GSI believes that the standardization can help further development and popularizing of this new technology. However, the standardization might narrow the development of techniques and reduce incentives for new research and development. Taking into account this risk, the GSI intends to continue reviewing the standard and continue the research and development of this promising technology.

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TECHNICAL ASSISTANCE AND TRANSFER OF TECHNOLOGY

Technical co-operation

Paper submitted by Japan

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The Geographical Survey Institute (GSI), the Hydrographic Department (HD), and the Geological Survey of Japan (GSJ) are engaged in the following activities, in order to render technical assistance and implement the transfer of technology in the field of cartography.

-GSI-

1. The training of technical personnel from developing countries:

The GSI, sponsored by the Japan International Cooperation Agency (JICA), has been conducting training courses which cover geodetic survey, photogrammetry, and map compilation & reproduction.

2. The dispatchment of Technical Experts:

The GSI, in collaboration with the International Engineering Consultants Association(IECA), has sent technical experts in the fields of geodetic survey, photogrammetry and map complilation & reproduction to countries in South Asia, Middle East Africa, Centeral & South America and Oceania.

3. Technical Cooperation in Mapping Projects:

Mapping projects in developing countries have been conducted by the IECA, acting as contractor for the JICA under the supervision of the GSI. So far, 14 projects have been completed and 7 others are in progress, in South Asia, Middle East Africa and Central & South America.

-HD-

1. The training of technical personnel from developing countries:

The HD, sponsored by the JICA, has been conducting training courses in hydrographic survey, physical oceanographic survey, and nautical charting.

2. The dispatchment of Technical Experts:

The HD has sent technical experts, mainly to East Asian countries, in the fields of tide and tidal current studies, hydrographic and oceanographic surveys and observations as well as Notices to Mariners and navigational warnings.

-GSJ-

1. The training of technical personnel from developing countries:

The GSJ has been conducting 2 training courses, in offshore prospecting methods and groundwater development.

2. Cooperative Research:

The GSJ has been conducting 6 cooperative research projects with such countries as

Pakistan and the Philippines for the study of mineral deposits, etc.

3. Cooperation with International Organizations:

The GSJ has been participating in various projects of international organizations. The GSJ is especially involved in the compilation of maps for the various projects of the Commission for the Geological Maps of the World (CGMW). The GSJ is responsible for the compilation of various thematic maps for the North-West Quadrant of the Circum-Pacific Map Project.

4. Bilateral Technical Cooperation:

The GSJ has sent technical experts in the fields of geological survey, mineral resources, geochemistry, etc., to developing countries in Southeast Asia, Central America, etc.

CHAPTER 1. TECHNICAL COOPERATION IN SURVEYING AND MAPPING

Guided by the conviction that a national base map of an appropriate scale enhances the efficient utilization, development and conservation of the land and its natural resources, as well as providing for essential infrastructure, the Geopraphical Survey Institute (GSI) of the Government of Japan began its technical assistance in 1963. Major features of such activities can be grouped into three categories; namely, training, dispatching of experts and mapping projects, which are conducted through the Japan International Cooperation Agency (JICA) commissioned by the Ministry of Foreign Affairs.

1. Training

1.1 Group training

During the Second UN Regional Cartographic Conference for Asia and the Far East held in Tokyo in 1958, the need for organizing group training courses in surveying and mapping has been translated into concrete terms. In light of this, the GSI initiated group training courses in 1963, the scope of which covers geodetic surveying, photogrammetry, and map compilation and reproduction. Each of them was conducted at three year intervals. Each course ranges from six to seven months in length. However, both the social and technical situations have changed and also demands of developing countries have diversified. Therefore, GSI modified the courses which were geodetic surveying, mapping and planning & management. But GSI is still planning the last one. The time periods for the courses are approximately six months, eight and two. The program is organized to provide both lectures and practical training in major subjects

The GSI has provided group training courses to 251 participants from 44 countries.

a. Geodetic Surveying Course

This course is aimed at introducing participants to the design of horizontal and vertical geodetic networks, adjustment by least squares in geodetic survey, trilateration and traversing, using EDM, satellite positioning and precise leveling, through lectures and practical training. The course includes such traditional methods as triangulation and astronomical observation for latitude, longitude and azimuth, while gravity and geomagnetic observations are included as applied subjects.

b. Mapping course

After a series of lectures required for understanding the theory of photogrammetry, geographical survey, map compilation and reproduction in the case of 1:25,000 scale topographic map and some thematic map making, trainees try to practice them by using instruments and tools.

c. Planning and management

The aim of this course is to foster an engineer who can make a suitable plan of surveying and mapping, which harmonize with development and stability of the national economy. The engineer should be a superintendent who can form a plan of survey education and training that are conducted by an appropriate organization and enforcement structure. Hence the program contains the present situation of surveying and mapping, survey planning, quality control, process control, latest technology, preservation of environment, measurement of safety, etc.

d. Follow-up team

To follow up on the ex-participants of the Group Training Course in Surveying and Mapping, a team was dispatched to the countries of Panama and Peru in 1989.

1.2 Individual Training

The individual training program is prepared in order to meet the needs of each trainee and his home government. The training period lasts one to five months. Up-to 1990, 86 trainees from 24 countries were accepted.

2. The Dispatching of Experts

In 1964, the GSI sent out four senior staff members to survey the national boundaries of Saudi Arabia. Since then, the GSI and the International Engineering Consultants Association (IECA), a public service corporation functioning under the supervision of the GSI and which consists of major aero surveying companies in Japan, have sent 171 senior, experienced, engineers as technical assistance experts. 121 of them were dispatched as short-term experts, who generally remain from several weeks to two months, to carry out

particular projects based on the requests addressed to the Government of Japan by the recipient governments, while others are long-term experts who cooperate with their host government.

Table 1. Dispatching of long-term experts

Indonesia	Control point survey	GSI	1975-1976	
	"	GSI	1975-1977	
	"	GSI	1977-1978	
	Photogrammetry	GSI	1978-1980	
Malawi	Surveying & mapping	GSI	1975-1977	Volunteer *1
Liberia	Geodetic surveying	GSI	1978-1980	
	Photogrammetry	IECA	1978-1980	
Venezuela	Geomophology	GSI	1978-1980	
	"	*2	1981-1985	
Saudi Arabia	Photogrammetry	GSI	1979-1982	
	Printing	GSI	1979-1981	
	Photogrammetry	* 3	1979-1982	
	Mapping	IECA	1979-1981	
	Map compilation	IECA	1979-	in progress
	Photo processing	IECA	1979-1982	
	Printing	GSI	1981-1983	
	Mapping	IECA	1981-1984	
	Photogrammetry	GSI	1982-1984	
	Photo processing	IECA	1982-1884	
	Printing	GSI	1983-1985	
	Mapping	GSI	1984-1986	
Nepal	Surveying & mapping	GSI	1980-1981	Volunteer *4
Papua New Guinea	Photogrammetry	GSI	1981-1983	
	"	GSI	1983-1985	
	"	GSI	1985-1987	
	Geodetic surveying	GSI	1987-1989	
	"	GSI	1989-	in progress
Bolivia	Photogrammetry	IECA	1981-1982	
Kenya	Geodetic surveying	IECA	1981-1983	
	"	IECA	" - "	
	"	IECA	" - "	
	"	GSI	1983-1985	
	"	IECA	" - "	
	"	IECA	1985-1987	
	"	GSI	1986-1989	

	〃	IECA	1987-1989	
	〃	GSI	1989-	in progress
	〃	IECA	〃	〃
Guinea	Geodetic surveying	IECA	1982-1984	
	〃	IECA	〃 - 〃	
Panama	Atlas	GSI	1983-1986	
	Printing	GSI	1985-1988	
Philippines	Geodetic surveying	GSI	1985-1986	
Peru	Photogrammetry	GSI	1986-1988	
	〃	GSI	1988-	in progress
	Geodetic surveying	IECA	1990-	in progress
Malaysia	Geodetic surveying	GSI	1988-1990	
Costarica	Mapping	GSI	1990-	in progress

*1, *4 Dispatched as Japan Overseas Cooperation Volunteers.

*2 Dispatched from Niijima Senior High School on GSI's recommendation.

*3 Dispatched from Geological Survey of Japan.

3. Mapping projects

In 1971, the GSI started its first overseas mapping project in Indonesia with the objective of preparing a national base map of that country. The role of the GSI in this field is to give advice to both the authorities concerned in Japan, as well as in the host countries, on all aspects of surveying and mapping of the projects and to supervise the actual work.

The projects are conducted by the IECA, acting as contractor for the JICA under the supervision of the GSI, which is well equipped and staffed to tackle overseas surveying and mapping. Such projects include all the related work, including aerial photography, and control point surveying and field reconnaissance, such as checking the geographical names. Some of them were conducted in collaboration with the recipient governments. Most of them consisted of topographic mapping. The mapping projects which are finished as well as those in progress, are as follows:

Table 2. Overseas Mapping Project

Indonesia	Aerial photo	1: 50,000	fiscal
Barito River Basin	Area	19,300 ㎢	1971-1974
	Mapping	1: 50,000	
	Area	19,300 ㎢ 34 sheets	
Upperstream Area of the	Aerial photo	1: 50,000	fiscal
Negara River Basin	Area	10,000 ㎢	1983-1985

	Mapping	1: 50,000	
	Area	6,500 km² 9 sheets	
Downstream Area of the Negara River Basin	Aerial photo	1: 20,000	fiscal
	Area	6,300 km²	1983-1985
	Photomapping	1: 10,000	
	Area	1,200 km² 48 sheets	
Tanzania Musoma Area	Aerial photo	1: 50,000	fiscal
	Area	12,730 km²	1973-1976
	Mapping	1: 50,000	
	Area	12,730 km² 23 sheets	
Bolivia Chapare Area	Aerial photo	1: 60,000	fiscal
	Area	30,000 km²	1974-1977
	Mapping	1: 50,000	
	Area	30,000 km² 44 sheets	
Kenya East Area	Aerial photo	1: 60,000	fiscal
	Area	30,000 km²	1975-1980
	Mapping	1: 50,000	
	Area	27,000 km² 37 sheets	
East Area (Thematic map)	Thematic mapping		fiscal
	Area	14,700 km²	1981-1983
	1: 50,000	3 themes 12 sheets each	
	1:100,000	2 themes 4 sheets each	
South Area	Aerial photo	1: 60,000	fiscal
	Area	29,800 km²	1987-1990
	Mapping	1: 50,000	
	Area	29,800 km² 43 sheets	
Guinea Whole Country	Aerial photo	1:100,000	fiscal
	Area	245,000 km²	1977-1981
	Mapping	1: 50,000	
	Area	12,000 km² 16 sheets	
	Photomapping	1: 50,000	
	Area	233,000 km² 372 sheets	
Panama The Caribbean Coasta Area	Aerial photo	1: 60,000	fiscal
	Area	8,000 km²	1978-1980
	Mapping	1: 50,000	
	Area	6,000 km² 12 sheets	
Philippines Cagayan Valley	Aerial photo	1: 30,000	fiscal
	Area	15,000 km²	1978-1982
	Mapping	1: 25,000	
	Area	11,000 km² 72 sheets	

	Photomapping	1: 10,000		
	Area	300 km²	12 sheets	
National Capital Region	Mapping	1: 10,000		fiscal
	Area	1,500 km²	57 sheets	1985-1988
	Thematic Mapping	1: 10,000		
	Area			
	Land use map	823 km²	33 sheets	
	Land condition map	484 km²	16 sheets	
Peru	Aerial photo	1: 60,000		fiscal
Satipo Area	Area	30,000 km²		1982-1986
	Mapping	1: 25,000		
	Area	12,500 km²	64 sheets	
Lima Metropolitan Area	Aerial photo	1: 30,000		fiscal
	Area	1,570 km²		1989-
	Mapping	1: 10,000		
	Area	1,250 km²	50 sheets	
	Land use map	500 km²	21 sheets	
Tunisia	Aerial photo	1: 80,000		fiscal
Whole Country	Area	164,000 km²		1985-1988
	Mapping	1:200,000		
	Area	83,000 km²	17 sheets	
Central Region	Aerial photo	1: 60,000		fiscal
	Area	35,500 km²		1990-
	Mapping	1: 50,000		
	Area	27,000 km²	45 sheets	
Thailand	Aerial photo	1: 20,000		fiscal
Bangkok Metropolitan Area	Area	4,000 km²		1986-1988
	Mapping	1: 10,000		
	Area	2,000 km²	61 sheets	
	Mapping	1: 4,000		
	Area	300 km²	40 sheets	
Morocco	Aerial photo	1: 40,000		fiscal
Topographic Mapping	Area	8,500 km²		1988-1990
	Mapping	1: 25,000		
	Area	8,500 km²	57 sheets	
Senegal	Aerial photo	1: 60,000		fiscal
Western Area	Area	25,500 km²		1988-
	Mapping	1: 50,000		
	Area	25,000 km²	43 sheets	
Costa Rica	Aerial photo	1: 20,000		fiscal

San Jose Metropolitan Area	Area	1,600 km²		1988-
	Mapping	1: 10,000		
	Area	1,600 km²	79 sheets	
	Land use map	800 km²	40 sheets	
Nepal	Aerial photo	1: 50,000		fiscal
Lumbini Zone	Area	9,000 km²		1990-
	Mapping	1: 25,000		
	Area	9,000 km²	81 sheets	

CHAPTER 2. TECHNICAL COOPERATION IN HYDROGRAPHY

Ⅰ. Forms of Technical Cooperation

Technical cooperation programs carried out by the Government of Japan range from acceptance of trainees in Japan, dispatch of Japanese experts and provision of equipment and materials to developing countries, as well as project-type technical cooperation combining organically the preceding three programs, development surveys, etc. The governmental institution in charge of the implementation of those technical cooperation programs on an unified basis is the Japan International Cooperation Agency (JICA).

Ⅱ. Training Courses

The Hydrographic Department of Japan is currently conducting three group training courses on the JICA basis as follows:

1. Group Training Courses in:

(1) Hydrographic Survey

This Group Training Course has been recognized by the FIG/IHO International Advisory Board as Category B Course pertaining to Specialization in Nautical Charting and Port and Near Shore Surveys since June 1, 1988.

a. Duration: From April to November every year.

b. Curriculum:

The curriculum of the course is constructed with lectures and practice strictly complying with the requirements under the International Standards of Competence for

Hydrographic Surveyors, 5th edition, 1988.

- Lectures: Abt. 74 days
- Practice: Abt. 17 days
- Field/shipboard training: Abt. 33 days
- Observation and study tour: Abt. 19 days

c. Qualifications of Applicants:

Applicants should:

- be nominated by their government in accordance with the procedures stipulated in the General Information on the course;
- be technical college graduates or equivalent with at least two years occupational experience in hydrographic services;
- have obtained credits for two years' course of mathematics and physics at least on the level of technical college or equivalent educational institution;
- be presently employed at the national hydrographic office or other related organizations;
- have a sufficient command of spoken and written English; and
- be not more than forty years of age.

Number of participants accepted to Group Training Course in Hydrographic Survey (1986-89):

Country	1986	1987	1988	1989	Total
Bangladesh		1	1	1	3
Burma (Myanmar)	1	1			2
Costa Rica	1	1			2
Cote d'Ivoire			1	1	2
Egypt	1	1	2	2	6
Indonesia	1	2	1	1	5
Korea	1	1		1	3
Malaysia	1	1		1	3
Pakistan		1	2	1	4
Panama	1				1
Philippines	1	1	1	1	4
Sri Lanka	1	1			2
Thailand	1		1	1	3
Total	10	11	9	10	40

(2) Physical Oceanographic Survey

a. Duration: from November to March, conducted alternately with the Group Training Course in Nautical Charting, every year.

b. Curriculum:

- Lectures: Abt. 39 days
- Practice: Abt. 12 days
- Field/shipboard training: Abt. 14 days
- Observation and study tour: Abt. 16 days

c. Qualifications of Applicants:

Applicants should:

- be nominated by their government in accordance with the procedures stipulated in the General Information on the course;
- be presently employed at the national hydrographic office or other related organizations, and currently engaged in physical oceanographic surveys and research such as offshore and coastal oceanographic observations, tide and tidal current observations, oceanographic data processing, analysis and management;
- have basic qualification or some experience in hydrography, oceanography, or relevant discipline, and preferably be college graduates or equivalent with some occupational experience in oceanographic survey and research;
- have a sufficient command of spoken and written English; and
- be not more than forty years of age.

d. Remarks:

This Group Training Course will be renovated in a future course to be conducted from 1992, in accordance with demands, suggestions, requests, etc. made by developing countries which have been sending participants to this course.

(3) Nautical Charting

a. Duration: From November to March, conducted alternately with the Group Training Course in Physical Oceanographic Survey, every year.

b. Curriculum:

- Lectures: Abt. 34 days

- Practice: Abt. 22 days
- Field/shipboard training: Abt. 10 days
- Observation and study tour: Abt. 10 days

c. Qualifications of Applicants:

Applicants should:

- be nominated by their government in accordance with the prpcedures stipulated in the General Information on the course;
- be presently employed at the national hydrographic office or other organizations which are engaged in carrying out hydrographics for safe navigation of ships, nautical charting and oceanographic survey for utilization of the ocean;
- be not more than thirty-five years of age;
- have a sufficient command of spoken and written English; and
- be a graduate of a junior college or special school graduate or equivalent.

Number of participants accepted to Group Training Courses in Physical Oceanographic Survey (PO) conducted in 1986 and 88 as well as in Nautical Charting (NC) conducted in 1987 and 89:

country	1986 (PO)	1987 (NC)	1988 (PO)	1989 (NC)	Total (PO)	(NC)
Argentina	1		1		2	0
Bangladesh		1	1	1	1	2
Columbia	1				1	0
Costa Rica				1	0	1
Egypt	1		1	1	2	1
Fiji				2	0	2
Indonesia	1	1		1	1	2
Korea		1	1	1	1	2
Malaysia	1	1	1	1	2	2
Nigeria			1		1	0
Philippines	2	1	1	1	3	2
Sri Lanka		1			0	1
Thailand		1		1	0	2
Uruguay	1				1	0
Total	8	7	7	10	15	17

2. Individual Training

Individual training is divided into two categories: counterpart training and ad hoc individual training. In the counterpart training, the counterparts in the countries which receive JICA experts, project cooperation, development survey, etc. are admitted to Japan for training, to increase the effectiveness of these technical cooperation programs. Determination of the number of persons to be admitted to the individual training is made by taking into consideration such factors as past performance. The countries concerned are informed of the quota in advance.

Individual Training conducted in 1986-89

country	1986	1987	1988	1989	Total
Malaysia	1			1	2
Philippines		1	1	1	3
Total	1	1	1	2	5

3. Application Procedures

To invite applicants to these group training courses, General Information (G.I.) pamphlets containing information on the conditions for admission to each course, the content of the courses, etc. are sent through diplomatic channels to the governments of the developing countries concerned.

Determination of the number of persons to be admitted to the individual training courses is made by taking into consideration such factors as past performance. The countries concerned are informed of the quota in advance. They then present requests which they want to send their trainees within their quota.

Ⅲ. Dispatch of Experts

The dispatch of experts is accomplished in various ways. In all cases, its main purpose is to transfer the knowledge and technology of the experts to the people of developing countries, through orientation, survey and research, advice, etc. The experts are dispatched by JICA in the following ways: According to requests submitted by developing countries, experts are sent from Japan to the government agencies of such countries.

The procedure for the dispatch of experts from Japan begins with a request for assistance presented to the Government of Japan through the Japanese embassy by the government of the developing country concerned. The request is made using a Form A-1, which should contain information on the background of the request, the duties of the

expert, the institution to which the expert will be assigned, the post to be occupied by the expert, the required number of years of experience, period of stay in the recipient country, etc.

Expert in	Dispatched to	Duration
Tidal observation	Department of Survey & Mapping, Malaysia	Oct.1985 - Oct.1987
Hydrographic survey	Bureau of Coast & Geodetic Survey, Philippines	Oct.1985 - Oct.1987
Tidal current prediction	Suez Canal Authority, Egypt	Nov.1986 - Jan.1987
Tidal observation	Department of Survey & Mapping, Sarawak, Malaysia	Oct.1987 - Oct.1989
Oceanographic date banking	Coast & Geodetic Survey Department, Philippines	Jan.1988 - Jul.1988
Hydrographic survey	Bureau of Coast & Geodetic Survey, Philippines	Jan.1988 - Oct.1988
Tidal current prediction	Suez Canal Authority, Egypt	Apr.1988 - Jun.1988
Electronic chart	Arab Maritime Transport Academy, Egypt	Dec.1988
Notices to mariners & radio navigational warnings	Coast & Geodetic Survey Department, Philippines	Dec.1988 - Sep.1989
Hydrographic survey	Cost & Geodetic Survey Department Philippines	Apr.1989 - Oct.1989
Hydrographic survey (Seminar)	Coast & Geodetic Survey Department, Philippines	Jul.1989
Oceanographic data banking	Coast & Geodetic Survey Department, Philippines	Oct.1989 - Aug.1990
Tidal observation	Department of Survey & Mapping,	Oct.1989 - Oct.1991

	Malaysia	
Hydrographic survey	Coast & Geodetic Survey Department, Philippines	Oct.1989 - Oct.1991
Notices to mariners & radio navigational warnings	Coast & Geodetic Survey Department, Philippines	May 1990 - Dec.1990

Ⅳ. Provision of Equipment and Materials

The objective of the program for provision of equipment and materials is to contribute to the economic and social development of developing countries by facilitating technical training, technology transfer, etc. with the provision of needed equipment and materials. When this program is combined with the dispatch of experts, and technical training in Japan, it can enhance the effectiveness of cooperation.

The procedure is as follows:

(1) The demands of the government of a developing country are first studied by the Japanese embassy, and based upon the results of this study, the implementation plan for the aid is prepared by the Ministry of Foreign Affairs, Japan.

(2) When the official request is presented, JICA starts the procedures to acquire the equipments requested on the basis of consultations with the Ministry of Foreign Affairs.

Ⅴ. Project-Type Technical Cooperation

Three types of technical cooperation programs of training, dispatch of experts and provision of equipment can be implemented independently, but in the interest of better coordination and more effectiveness, they sometimes are combined to a new form of technical cooperation which is called the "project-type technical cooperation".

Recently, a smaller scale project-type technical cooperation program has become implemented. This program is called "Mini-project-type technical cooperation", with a maximum period of 3 years for its implementation schedule.

As for the normal procedure of implementation, a Record of Discussions (R/D)is prepared for each project and is signed by the Japanese executing agency (JICA) and the

authority concerned in the recipient country. This recommends the project to the respective governments for their acceptance, the details of the implementation plan as well as the obligations to be observed by the two parties concerned.

CHAPTER 3. TECHNICAL COOPERATION IN GEOLOGICAL SURVEYS

The Geological Survey of Japan (GSJ) has long been involved in geological programs of international importance. The scope of these activities is steadily expanding into all phases of geosciences and these programs are gaining increasing importance within the survey.

These international activities can be largely grouped into; cooperative research carried out jointly with its counterpart institution, participation in scientific and technical cooperation programs of the Japanese Government and the training of scientific and technical personnel of developing countries.

1. Cooperative Research

Six cooperative research projects have been carried out with the national geological services of the recipient countries. These have been carried out as a part of the international research cooperation program of the Agency of Industrial Science and Technology (AIST).

a. China (1986-1989): Wuhan College of Geology

The relationship between coal properties and depositional environment was clarified through studies on revealing mechanisms in the formation of coal-forming Swamps and coalification degree in Liaoning coal field area.

b. China (1987-1989): Center for Remote Sensing in Geology

Application technique of Landsat TM data for regional geologic structure analysis was studied in the north-eastern continental region of China. Regional structure was revealed using techniques on lineament extraction, spectral and textural classification.

c. Pakistan (1987-1990): Geological Survey of Pakistan

Geology, igneous activity and mineralization related to the collision event were surveyed in northern Pakistan continental crust. Mineral exploration technique in the collision zone has been studied on the basis of the results.

d. Philippines (1987-1991): Mines and Geosciences Bureau

The genesis of hydrothermal gold deposits and Co- and Pt- bearing island arc ophiolite complex in the Philippines has been studied to establish the exploration technique for those minerals. The U.S. Geological Survey has been cooperating in this

program jointly with the GSJ.

e. Philippines (1988-1991): Mines and Geosciences Buerau

Establishment of pricise rock and time stratigraphy of typical sections of sedimentary basing in the Philippines has been studied to facilitate the search for energy and mineral deposits. Paleontological, sedimentary petrological and geochemical analyses have been revealing properties of each basin.

f. Thailand (1990-1992): Department of Mineral Resources

Concentration mechanism of rare metal, especially rare earth, elements in weathering crust of granitic rock in Thailand has been studied by means of geological, mineralogical and geochemical approach. Potentiality of such resources has been evaluated for utilization in the rare metal industry.

2. Cooperation with International Organizations

The GSJ is participating in the various projects of international organizations. They include various agencies of the United Nations, particularly those bodies affiliated with the Economic and Social Commission for Asia and the Pacific (ESCAP). Experts have participated in the activities and conferences of the Committee for Coordination of Joint Prospecting for Mineral Resources in Asian Offshore Areas (CCOP), and that for the South Pacific (CCOP/SOPAC). Also the GSJ is involved in the compilation of various maps for the projects of the Commission for the Geological Map of the World (CGMW).

The GSJ is responsible for the compilation of various thematic maps of the North-West Quadrant of the Circum Pacific Map Project. The maps include geography, tectonics, geologic, energy and mineral resources. A panel consisting of the representatives of national geological services of the countries bordering the western Pacific and also experts from agencies, universities, and other institutions has been formed and is responsible for the project. The geographic, geologic, geodynamic and plate tectonic maps have already been published and others will be completed soon.

3. Bilateral Technical Cooperation

The GSJ is involved in technical cooperation programs of the Japanese Government. The activities of the survey personnel in the scientific and technical assistance program cover virtually all phases of the geoscientific spectrum. The length of these activities range from a few weeks to several years.

During the period from 1986 to 1990, these activities were conducted in Argentina, Brazil, China, Honduras, Indonesea, Madagascar, Mexico, Mongolia, Oman, Pakistan, Peru, the Philippines, Thailand, Turkey, Venezuela, Yemen and the South Pacific marine area. The following list shows only the activities of long term experts.

Country	Field	No. of persons	Term
Thailand	Geological Survey	(1)	1984-1987
Turkey	Mineral Resources	(1)	1985-1987
Mexico	Mineral Resources	(1)	1986-1988
Fiji	Mineral Resources	(1)	1987-1988
Thailand	Geophysics	(1)	1987-1989
Turkey	Mineral Resources	(1)	1987-1989
Thailand	Geophysics	(1)	1989-1991
Fiji	Marine Geology	(1)	1990-1992

4. Training

Training of technical personnel from the developing countries in geosciences is conducted as a part of the technical cooperation scheme of the Japanese Government. This includes two regularly scheduled courses held each year in offshore prospecting methods and groundwater development. Both of these courses have been conducted annually since 1967 and about twenty scientists and engineers from various countries, such as Southeast Asia, the Middle East Africa, Central and South America, participate each year.

The total number of participants so far have included five hundred persons from fifty countries. The duration of the courses is seven months for marine geoscience and four months for groundwater courses.

The groundwater course, however, was closed in 1989 and resulted with 245 participants from 44 countries.

Since 1988, a new group training course, advanced industrial technology, has started under the coordination of AIST. About ten selected scientists from developing countries participate in this course and have individual training in each field for ten months at national institutes of AIST. The GSJ has accepted one or two researcher(s) in the field of geosciences every year.